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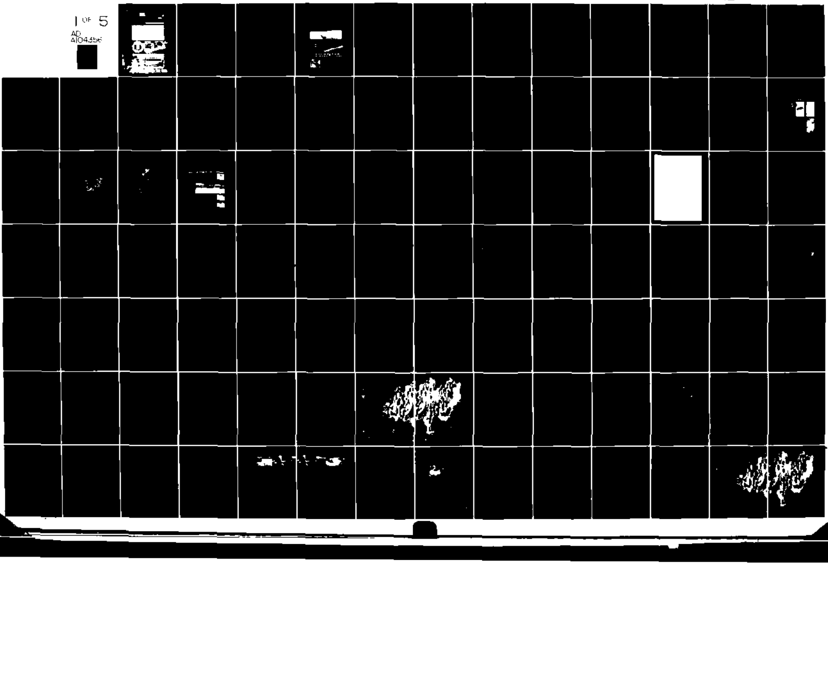

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CHAPTER 3: AFFECTED ENVIRONMENT

Chapter 3 describes the potentially affected environment in Nevada, Utah, Texas and New Mexico. Environmental features of both bi-state regions and of operating base vicinities are presented. Resources addressed include:

water, air, mining, vegetation, and soils

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Item 20 (continued)

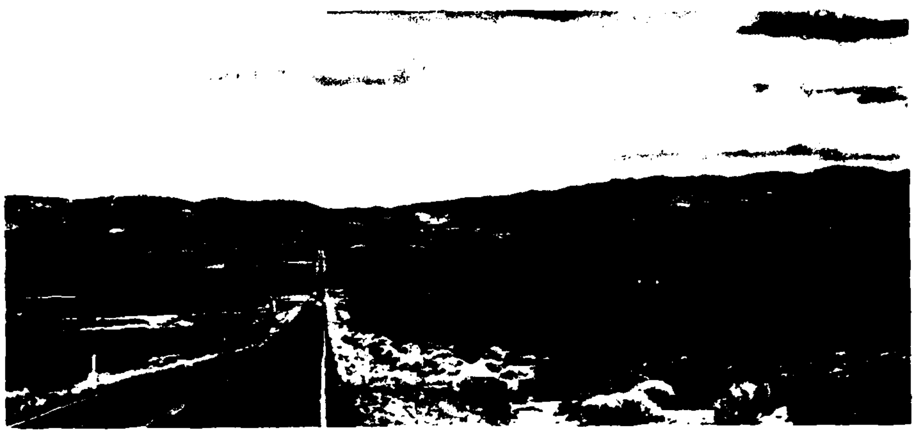
Wildlife, aquatic species, and protected plant and animal species

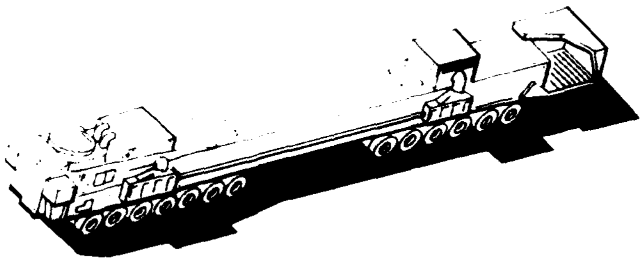
employment, population, public finance, transportation, construction resources, energy, land use, and recreation.

cultural resources, native american concerns, archaeological and historic features

III
Part I

Affected Environment





Environmental Impact Analysis Process

DEPLOYMENT AREA SELECTION AND LAND WITHDRAWAL/ ACQUISITION DEIS

DEPARTMENT OF THE AIR FORCE

DEPLOYMENT AREA SELECTION
AND
LAND WITHDRAWAL/ACQUISITION DEIS

CHAPTER 1: PROGRAM OVERVIEW

CHAPTER 1 PRESENTS AN OVERVIEW OF THE M-X SYSTEM AND THIS EIS INCLUDING:

- A DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES, INCLUDING SCHEDULE AND RESOURCE REQUIREMENTS
- AN OVERVIEW OF THE TIERED M-X ENVIRONMENTAL PROGRAM THAT INVOLVES SITE SELECTION AND LAND WITHDRAWAL
- A PRESENTATION OF PUBLIC SAFETY CONSIDERATIONS WITH PHYSICAL SECURITY AND SYSTEM HAZARDS
- A SUMMARY OF FEDERAL AND STATE AUTHORIZING ACTIONS ASSOCIATED WITH CONSTRUCTION AND OPERATIONS

CHAPTER 2: COMPARATIVE ANALYSIS OF ALTERNATIVES

CHAPTER 2 COMPARES THE ENVIRONMENTAL IMPACTS OF ALTERNATIVE M-X SYSTEM AND OPERATING BASE COMBINATIONS. DETAILS INCLUDE:

- THE SELECTION OF LOCATIONS FOR TWO SUITABLE DEPLOYMENT REGIONS, 200 CLUSTERS, AND SEVEN ALTERNATIVE OPERATING BASES
- PRESENTATION OF CONCEPTUAL CONSTRUCTION SCHEDULES, PERSONNEL REQUIREMENTS, AND RESOURCE NEEDS FOR EACH ALTERNATIVE
- COMPARATIVE ENVIRONMENTAL ANALYSIS BY ALTERNATIVE FOR EACH RESOURCE PRESENTED IN CHAPTERS 3 AND 4

CHAPTER 3: AFFECTED ENVIRONMENT

CHAPTER 3 DESCRIBES THE POTENTIALLY AFFECTED ENVIRONMENT IN NEVADA, UTAH, TEXAS, AND NEW MEXICO. ENVIRONMENTAL FEATURES OF BOTH BI-STATE REGIONS AND OF OPERATING BASE VICINITIES ARE PRESENTED. RESOURCES ADDRESSED INCLUDE:

- WATER, AIR, MINING, VEGETATION, AND SOILS
- WILDLIFE, AQUATIC SPECIES, AND PROTECTED PLANT AND ANIMAL SPECIES
- EMPLOYMENT, POPULATION, PUBLIC FINANCE, TRANSPORTATION, CONSTRUCTION RESOURCES, ENERGY, LAND USE, AND RECREATION
- CULTURAL RESOURCES, NATIVE AMERICAN CONCERNS, ARCHAEOLOGICAL AND HISTORIC FEATURES

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES TO THE STUDY REGIONS AND OPERATING BASE VICINITIES

CHAPTER 4 EXPANDS THE CHAPTER 2 ANALYSIS FOR EACH RESOURCE IN CHAPTER 3. ADDRESSING THE QUESTIONS RAISED IN SCOPING, CHAPTER 4 DISCUSSES THE FOLLOWING TOPICS ON A RESOURCE BY RESOURCE BASIS.

- THE REASON EACH RESOURCE IS IMPORTANT AND THE SOURCE OF SIGNIFICANT DIRECT AND INDIRECT IMPACTS
- THE INTERRELATIONSHIPS BETWEEN RESOURCES AND KEY CAUSES OF SHORT- AND LONG-TERM IMPACTS SUCH AS AREA DISTURBED AND POPULATION GROWTH
- MITIGATIVE MEASURES WHICH POTENTIALLY REDUCE IMPACTS
- A MATRIX OF POTENTIAL IMPACT SEVERITY BY GEOGRAPHIC AREA FOR THE PROPOSED ACTION AND EACH ALTERNATIVE

CHAPTER 5: APPENDICES

CHAPTER 5 CONTAINS AN M-X BASING ANALYSIS REPORT WITH APPLICATION OF SELECTION CRITERIA TO CANDIDATE BASING AREAS. ADDITIONAL SECTIONS INCLUDE:

GLOSSARY
ACRONYMS
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Affected Environment




AFFECTED ENVIRONMENT

INTRODUCTION

Geotechnically suitable land for the deployment of M-X in the Nevada/Utah region is shown in gray in Figure 3.1-1. Those areas in which there is currently most interest are shown in black. Geotechnically suitable land in the Texas/New Mexico region is shown in Figure 3.1-2. Environmental study area boundaries extend beyond the geotechnical limits. The extent to which environmental study areas exceeded the geotechnical limits varies according to the discipline under study.

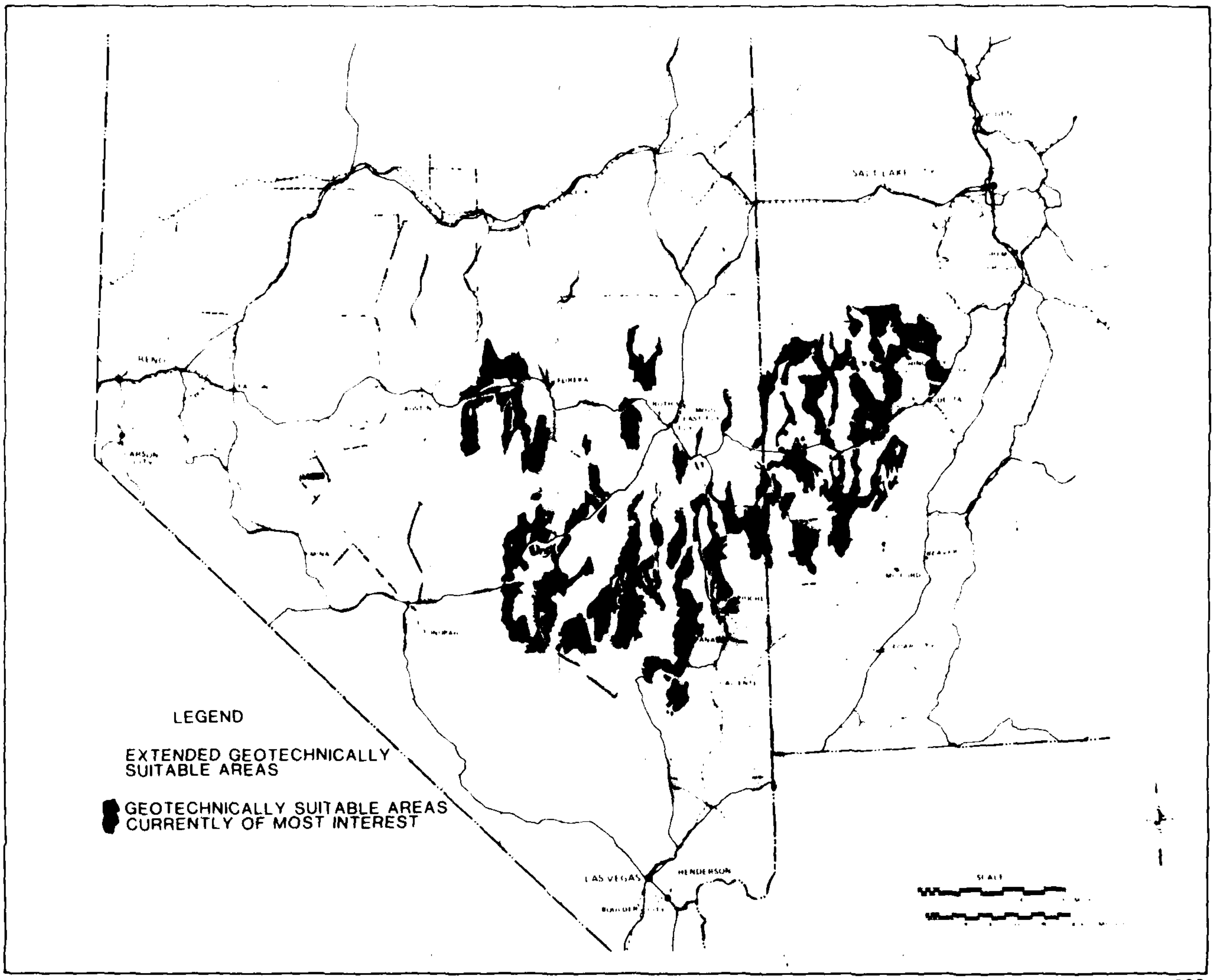

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Figure 3.1-1. Preferred (black) and extended (gray) geotechnically suitable areas in the Nevada/Utah study area.

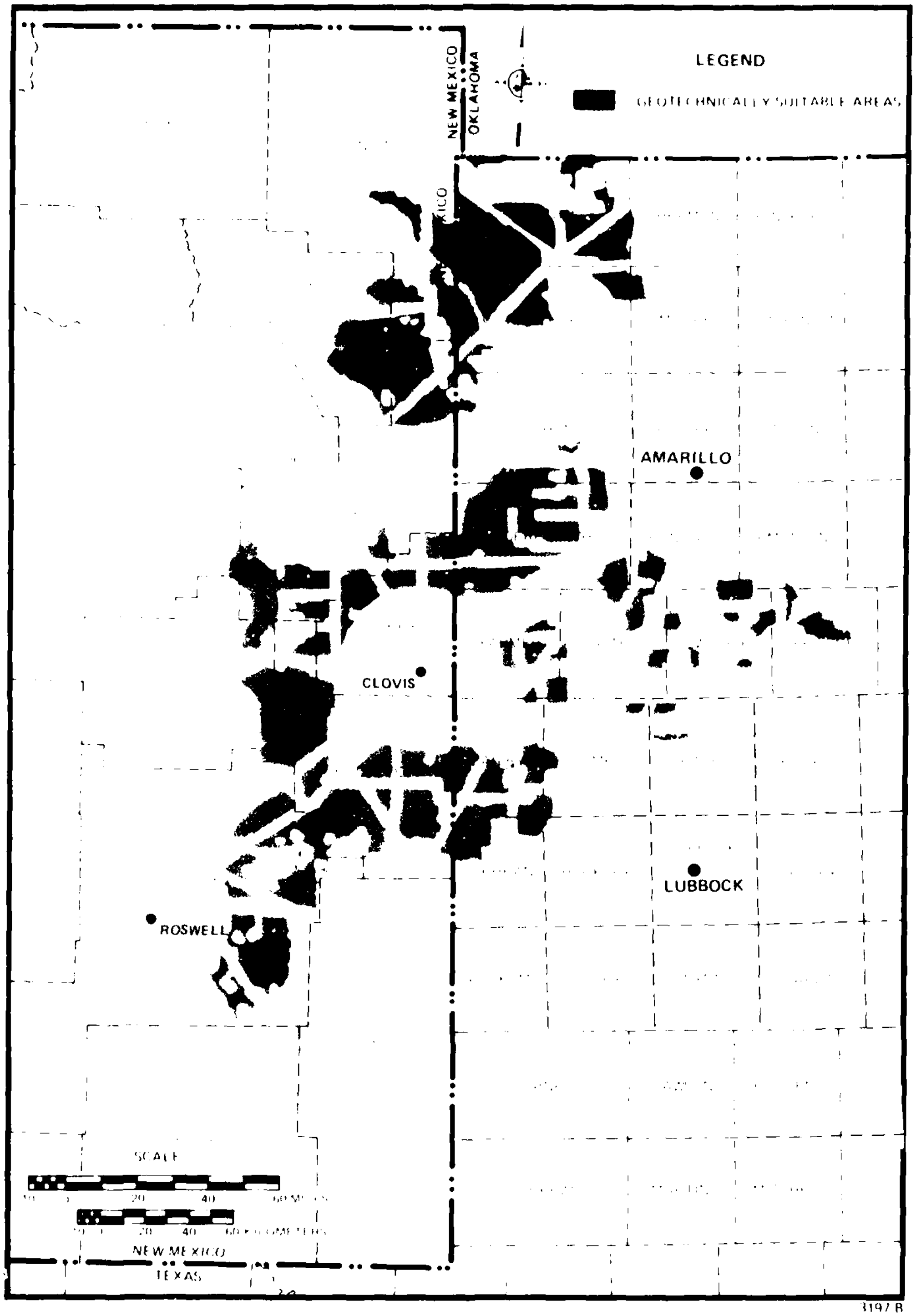

Figure 3.1-2. Geotechnically suitable area in the Texas/ New Mexico study area.

Nevada/Utah Regional Environment

REGIONAL ENVIRONMENT NEVADA/UTAH

INTRODUCTION (3.2.1)

The following sections describe the natural and human environment of the Nevada/Utah area. Included are descriptions of physical and biological resources: Groundwater, Surface Water, Air Quality, Mining and Geology, Vegetation and Soils, Wildlife, Aquatic Species, Protected Species, and Wilderness and Significant Natural Areas. Discussion of the human environment covers: Employment, Income and Earnings, Public Finance, Population and Communities, Transportation, Energy, Land Ownership, Land Use, Native American Resources, Archaeological and Historical Resources, and Construction Resources.

General Description of Study Area (3.2.1.1)

The region is located in the Basin and Range Province, with north- and south-oriented mountain ranges separated by high desert valleys. Most valleys have an interior drainage system; as a result, broad playas and alkali flats are common. Terrain is rugged and relatively sparsely populated. Precipitation is minimal, averaging about 8 in./yr. Agriculture is limited; the main rural economic activities are mining and grazing.

Description of Other Projects (3.2.1.2)

Major anticipated activities in the region of influence are associated primarily with mineral extraction and processing and/or electrical energy production. High prices of fuel oil have encouraged the search for substitute fuels and technologies for energy production. In the study area, coal, and to a lesser extent, geothermal steam are the major anticipated energy production activities. Precious metals prices have also increased dramatically, encouraging additional mining activities.

These circumstances are magnified in the region of influence. For example, in the Nevada counties of Eureka, Lincoln, Nye, and White Pine, mining activities are over 20 times as high as the national average.

Future projections have been separated into Baseline 1 and Baseline 2. The first set of projections are essentially an extrapolation of 1967-1978 growth trends in the Nevada/Utah region of influence (ROI). As noted below, Baseline 1 includes the following:

Baseline 1

- o Continuation of 1967-1978 growth trends
- o Construction of Anaconda Nevada Molybdenum Project (Nye County)
- o Metal mining Eureka, White Pine, and Lander counties
- o Expansion of oil and gas
- o Exploration in the Utah portion of the ROI

Baseline 2

- o Baseline 1
- o White Pine County
- o White Pine Power Project
- o Reopening Kennecott Copper Company mine
- o Millard County
- o Intermountain Power Project
- o Continental Lines Cement Plant
- o Brush Beryllium expansion
- o Precision-built modular homes
- o Martin-Marietta Cement Plant
- o Juab County
- o General Battery
- o UFCO Coal Loading Facility
- o Beaver County
- o Geothermal Power
- o Molybdenum Mining
- o Alunite mining and processing

Baseline 2, a high growth scenario, includes Baseline 1 plus the realization of the additional future events given above. There is a degree of uncertainty regarding each of these projects, though some may be more likely than others. The project list was discussed and coordinated with the Utah State Planning Coordinator's Office and University of Utah's Bureau of Business and Economic Research. This study's Baseline 2 corresponds with their Baseline 3. Other Projects currently planned, but not explicity assessed, include the following:

Allen Warner Valley Complex, 1985-88

- o Alton Mine, south Utah
- o Warner Valley Power Plant, St. George, Utah
- o Allen Power Plant, Clark County, Nevada
- o Coal Slurry lines from mine to plants
- o Transmission lines from plants to Southern California

Rocky Mountain Pipeline, proposed: 1985

Cove Fort Geothermal Power Plant, Millard County, Utah, 1984

Reid Gardner Power Plant #4, Clark County, Nevada, 1983

Mountain Fuel Coal Gasification Plant, 1990

Valmy Power Plant, Valmy, Nevada, mid-1980s

Mormon Mesa Solar Power Plant, proposed

In general, projects in addition to those considered for Baselines 1 and 2 were not considered because either their effect on employment was expected to be negligible, their probability of realization was deemed relatively low, or their principal effects were expected outside the Nevada/Utah ROI.

In Nevada, major opportunities for development are anticipated in minerals and energy production, particularly in the rural counties. In the Nevada study area, four large projects are anticipated: the White Pine Power Project, reopening of Kennecott Copper Company mine near Ruth, and metal processing in McGill, all located in White Pine County; and the Anaconda Nevada Molybdenum Project in Nye County. Table 3.2.1.2-1 presents employment projections of these three projects. Economic growth and changes will be pronounced in White Pine County from cumulative effects of the two projects there; employment growth is projected to equal as much as 5,800 jobs, over one-half of current county employment levels.

Fluctuations in the value of precious minerals can greatly affect the economics of Nevada's rural counties. Nevada mineral output dropped substantially from 1977 to 1978, largely because of the shutdown of Kennecott Copper Company mining operations in White Pine County. Depressed copper prices and increased production costs of meeting clean air regulations were the major factors in contributing toward this closure. In 1978, gold replaced copper as Nevada's leading mineral commodity for the first time in 50 years. Nevada ranked first in the nation in the production of barite, magnesite, and mercury, and second in gold.

Although mining employment in rural counties is a small percent of the total, the mining sector has major effects on other sectors of the economy, particularly construction and manufacturing. In general, employment in the mining sector includes only mineral extraction. Ore concentration is included in the manufacturing sector except in certain cases where the ore concentration process is located on the mineral extraction site. Basic metals refining is normally included in the manufacturing sector.

Mining activities have strong backward linkages with the construction industry. Prior to development of a major mineral deposit, large numbers of construction workers may be required for mine construction and ancillary minerals-processing plants. These workers will require housing and other services, adding to the construction impacts.

Economic activity is highly concentrated in mining in Eureka, Lincoln, Nye, and White Pine counties. This concentration could well increase in the 1980-1990 decade, due to the recent escalation of the prices of gold, silver, and other precious metals. Future development of opportunities would likely stress minerals development.

Table 3.2.1.2-1. Projected cumulative employment effects of selected major projects in the Nevada ROI counties, 1980-1990.

NEVADA	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	[illegible]
Nye County												
Anaconda Nevada Molybdenum Project	990	1,010	920	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	Molybdenum production; mine and mill [illegible] tons of ore per day.
White Pine County												
White Pine Power Project	–	–	–	–	120	620	1,450	2,430	2,150	1,350	820	[illegible] MW coal-fired power plant [illegible] unit train.
Kennecott Mine Reopening and Metal Processing	1,990	2,500	3,190	3,220	3,260	3,300	3,330	3,370	3,410	3,450	3,490	Copper production.
County Total	1,990	2,500	3,190	3,220	3,380	3,920	4,780	5,860	5,560	4,800	4,310	

Sources: ABT Associates, Inc., November 1979; Baker III, A., et al, January, 1979; Barone, R., et al, July, 1979; Bryant, G., February 26, 1980; Office of State Inspector of Mines, Nevada, January, 1979; Tilsey, F., February 26, 1980; Williams, J., February 8, 1980; Willie, J., February 26, 1980; Bureau of Business and Economic Research, College of Business, University of Utah, July 18, 1980.

Current economic activities have centered on mineral production possibilities in Nevada, particularly in the rural counties. Current minerals exploration in Nevada is proceeding at an annual rate of over $100 million, and $15 million is being spent on geothermal exploration. Although most geothermal exploration activities have occurred outside of the Nevada ROI counties, this may be more an indicator of feasible applications of geothermal energy than an indicator of potential geothermal supplies. Increased economic activities in the ROI counties would tend to operate together with increased exploration and development of geothermal resources.

In Utah, projected employment impacts of selected projects included in Baselines 1 and 2 are presented in Table 3.2.1.2-2. It indicates that Intermountain Power Project (IPP) is expected to have the largest effects, with a peak employment of 3,200 jobs in 1986. However, the Pine Grove Molybdenum Project, with a sustained employment level of 1,000 persons during operations, would also produce significnat employment growth in a comparably rural setting.

Table 3.2.1.2-3 presents Nevada/Utah employment projections for Baselines 1 and 2 for selected years through 1995. Growth diverges significantly only during the first 5-year forecast period where under Baseline 2 total ROI employment reaches 802,700 in 1985, compared to 786,900 for Baseline 1. In either case, however, annual employment growth forecasts are well below Nevada state's 5.7 percent average rate over the 1967-1977 period, but above Utah's 3.5 average rate over the same period (see Table 3.2.3.1-3). Subsequently, over the 1985-1990 period, employment growth under Baseline 2 dips below that of Baseline 1. In this period under Baseline 2, the economies of the Nevada/Utah ROI would be readjusting from rapid project growth, particularly the build-up of White Pine Power and IPP during the earlier forecast period. Over the 1990-1995 period, both employment growth scenarios are projected to yield average annual growth rates of 2.0 percent.

Table 3.2.1.2-3 indicates that only slight changes are forecast in sectoral employment shares over the forecast period. Only the percent of total ROI employment in government is forecast to decline by more than one percent over the entire 1980-1995 period, while only services' percent share is projected to increase by more than one percent.

Table 3.2.1.2-2. Projected cumulative employment effects of selected major projects in Utah ROI counties, 1980-1990.

UTAH	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	COMMENTS
Beaver County												
Alunite Mining and Processing	—	—	—	—	—	—	130	1,170	1,800	1,140	1,350	Alunite production: mine, mill and process 12,000 tons of ore/day
Roosevelt Hot Springs Geothermal Energy Exploration and Power Plant	—	90	110	80	90	100	100	100	100	100	100	4-year energy exploration; 20 MW geothermal power plant
[illegible] Molybdenum [illegible]	—	950	1,000	950	1,000	1,000	1,000	1,000	1,000	1,000	1,000	Molybdenum production: mine and mill 10,000 - 30,000 tons of ore day (estimate from Anaconda Moly).
Sub-Total	—	1,040	1,110	1,030	1,090	1,100	1,230	2,270	2,900	2,240	2,450	
Millard County												
[illegible]	—	—	170	330	1,200	2,400	3,200	3,100	2,600	1,900	800	3,000 MW coal-fired power plant - coal by unit train.
Continental Lime Cement Plant	50	40	80	80	80	80	80	80	80	80	80	Cement production.
Martin Marietta Cement Plant	550	640	620	160	160	160	170	170	170	170	170	Cement production.
Precision Build Modular Home Manufacturing	140	130	120	120	120	130	130	130	130	130	130	Modular Home Manufacturing
Sub-Total	740	810	990	690	1,560	2,770	3,580	3,480	2,980	2,280	1,180	

2925

Sources: [illegible] Sciences, July, 1980 and Bureau of Business and Economic Research, University of Utah, July 18, 1980.

Table 3.2.1.2-3. Employment projections by major industry, by place of residence, baselines 1 and 2, Nevada/Utah region of influence, 1980, 1985, 1990 and 1995 (as a percent of total employment).

[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE
Agriculture	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mining	1.7	[illegible]	[illegible]	1.6	[illegible]	[illegible]	[illegible]	[illegible]
Construction	[illegible]	[illegible]	6.4	6.9	[illegible]	6.4	[illegible]	[illegible]
Manufacturing	[illegible]	[illegible]	[illegible]	[illegible]	9.9	9.8	[illegible]	[illegible]
Transportation	[illegible]	[illegible]	[illegible]	6.6	6.1	6.1	6.1	[illegible]
Trade	[illegible]	[illegible]	21.9	21.7	21.9	21.8	[illegible]	[illegible]
Finance, Insurance and Real Estate	[illegible]	4.5	4.7	4.7	4.7	4.7	4.8	4.8
Services	[illegible]	[illegible]	27.9	27.6	28.4	28.3	[illegible]	[illegible]
Government	[illegible]	15.3	14.9	14.8	14.4	14.4	13.9	13.8
Non-Farm Proprietors	[illegible]	[illegible]	[illegible]	5.4	5.5	5.4	5.4	5.4
Total Employment	[illegible]	[illegible]	[illegible]	802,700	876,700	886,500	[illegible]	[illegible]
Average Annual Growth (percent) of Total Employment	[illegible]		1985-1990		1990-1995			
Baseline 1	[illegible]		2.2		2.0			
Baseline 2	4.3		2.0		2.0			

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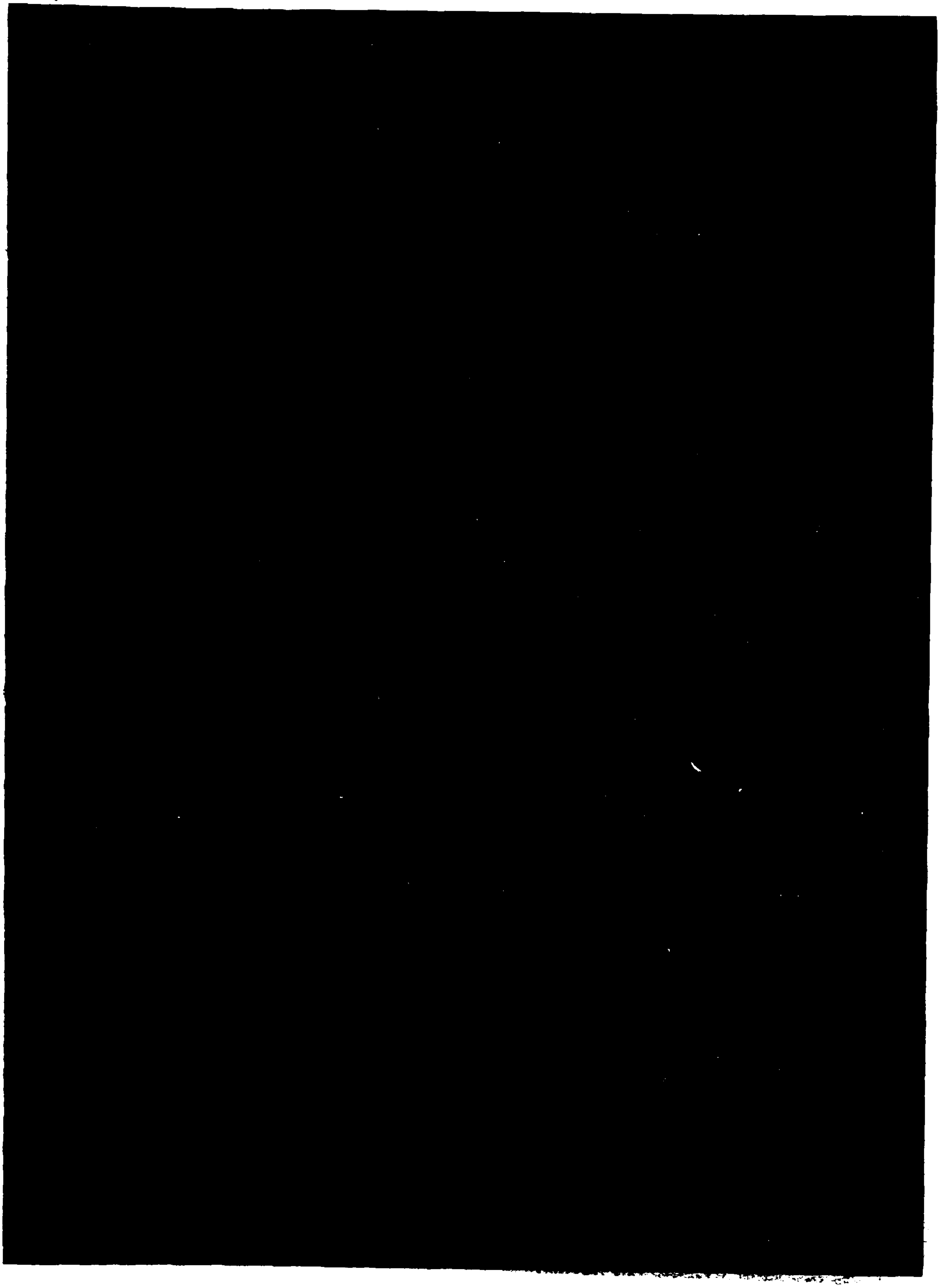
Source: Bureau of Business and Economic Research, University of Utah, October 198[illegible].



NATURAL ENVIRONMENT (3.2.2)

Groundwater Resources (3.2.2.1)

The Great Basin is a physiographic province that can be characterized hydrologically by a drainage system which has no surface outlet to the sea. Most of the Nevada/Utah siting area lies within this basin. The only exception to this is the White River system where surficially-connected valleys drain to the south and into the Colorado River.

The hydrologic cycle within the region, as illustrated in Figure 3.2.2.1-1, begins with precipitation in the mountainous areas. Rainfall and snowmelt provide the initial source of surface water. As runoff crosses the alluvial material in the valleys, some water percolates downward through the material and becomes part of the groundwater system. The remaining runoff flows through channels across the alluvial plain and discharges onto the valley floor (playa). This ponded water may infiltrate into the subsurface or evaporate into the atmosphere.

Maximum precipitation events occur more frequently in April and May in the north and in July and August in the south. Occurrence, amount, and type of precipitation are related to topographic orientation and elevation. Due to its higher elevation, the high plateau region receives more precipitation than other areas. Average annual precipitation ranges from 4 in. in lower valley floors to more than 16 in. in higher mountain ranges. Snowfall averages between 10 and 40 in. on valley floors and can exceed 80 in. in some mountains. A generalized estimate of average annual precipitation, with respect to elevation, is presented in Table 3.2.2.1-1 (Eakin, 1966).

A significant portion of precipitation in the study area is in the form of snow. In areas of significant snowfall, snowmelt accounts for most of the recharge from precipitation. The percent of average annual precipitation as it becomes recharge has been estimated (Eakin, 1966) and is presented in Table 3.2.2.1-1.

The two principle means by which water is lost from the Great Basin are evaporation of shallow groundwater and transpiration from plants called phreatophytes. A review of study area reconnaissance reports shows surface water evaporation estimates range from 3.5 to 5 ft per year. Transpiration is estimated at 0.1 ft for scattered vegetation up to 1.5 ft for wetlands and springs. The amount of recharge, which varies from less than one to about eight percent of the total precipitation.

The mountains and valleys comprising the Great Basin are the result of tectonic, volcanic and erosional processes (Osmond, 1960). A diagram showing the geology of a typical valley and enclosing ranges is shown in Figure 3.2.2.1-2. Much of the region is underlain by carbonate rocks at depth. These rocks have been altered by tectonic activity to produce the complexly folded and faulted mountain ranges. In addition, extensive areas throughout the region have been covered by extrusive volcanic rocks. Sediments resulting from the erosion of the carbonate and volcanic rocks comprise the bulk of the valley fill and consequently serve as storage areas for much of the water in the region. The generalized geohydrological characteristics of the various types of bedrock and valley fill found within the Great Basin are contained in Table 3.2.2.1-2.

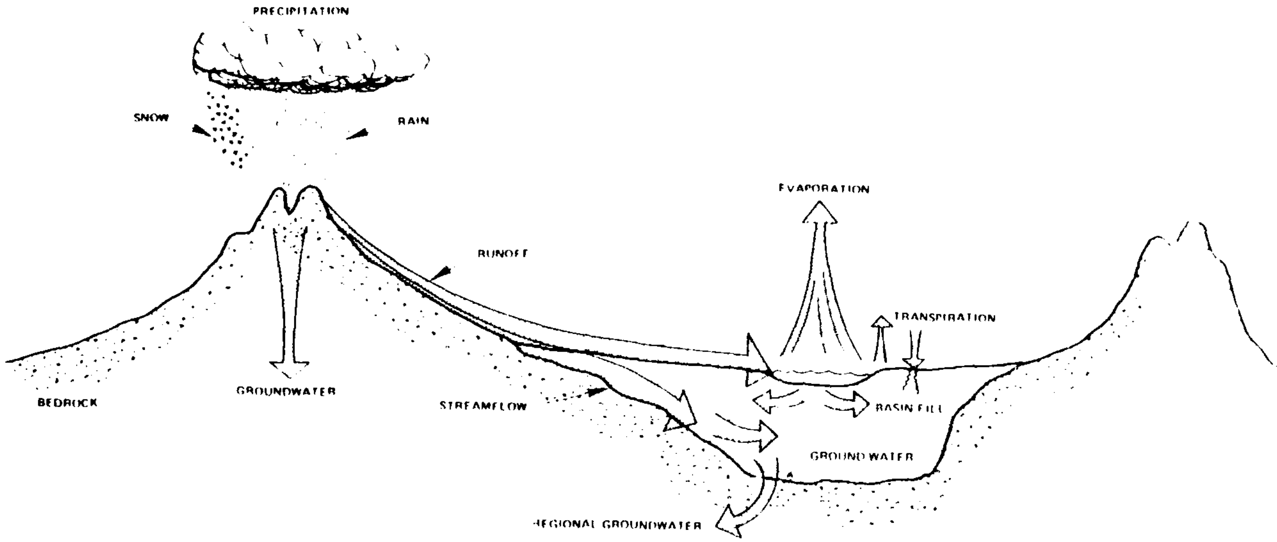


Figure 3.2.2.1-1. The hydrologic cycle.

Table 3.2.2.1-1. Assumed values for precipitation and percent recharge for several altitude zones in area of this report.

PRECIPITATION ZONE (in.)	ALTITUDE ZONE (ft)	ASSUMED AVERAGE ANNUAL PRECIPITATION (ft)	ASSUMED AVERAGE ANNUAL RECHARGE TO GROUNDWATER, PERCENT OF AVERAGE PRECIPITATION
Less than 8	Below 6,000	Variable	Negligible
8 to 12	6,000 to 7,000	0.83	3
12 to 15	7,000 to 8,000	1.12	7
15 to 20	8,000 to 9,000	1.46	15
More than 20	More than 9,000	1.75	25

Source: A Regional Interbasin Groundwater System in the White River Area, Southeastern Nevada, State of Nevada Water Resources Bulletin No. [illegible], Thomas E. Eakin, 1966. 808-1

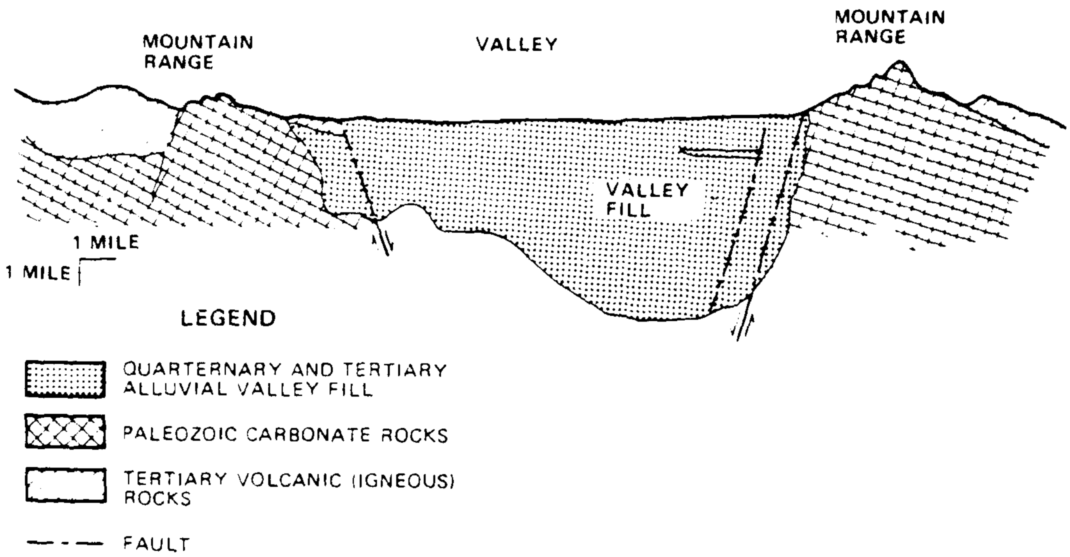


Figure 3.2.2.1-2. Generalized valley cross-section showing basin and range geology.

Table 3.2.2.1-2. Generalized lithology and water-bearing characteristics of hydrogeologic units in the Great Basin. (Page 1 of 2)

AGE	HYDROGEOLOGIC UNIT	LITHOLOGY	WATER-BEARING CHARACTERISTICS
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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Table 3.2.2.1-2. Generalized lithology and water-bearing characteristics of hydrogeologic units in the Great Basin. (Page 2 of 2)

AGE	HYDROLOGIC UNIT	LITHOLOGY	WATER-BEARING CHARACTERISTICS
Cenozoic Quaternary Valley Fill	Eolian dune sand	Composed mainly of fine to medium quartzose sand.	Permeable, retaining sufficient moisture to support vegetation. Generally unsaturated but locally may contain fresh perched ground water during the spring or early summer; may transmit water to underlying hydrologic units.
	Lacustrine deposits, playa	Lakebed clay, silt, and evaporites	Permeability generally low. Most precipitation and runoff reaching playa remains ponded until it evaporates. At such time, the thin playa deposits may be saturated for short periods. Locally may confine water in underlying aquifer.
	Stream-Channel alluvium	Mainly sand and gravel, but includes some clay and silt. Present as channel fill along larger streams.	Generally moderately permeable. Most deposits are saturated to or within a few inches of land surface during and for short periods following runoff, but water levels may be several feet below land surface and thinner sections may be dry during much of the summer.
	Alluvium and Colluvium	Mainly sand, gravel, and boulders with intermixed and interbedded clay and silt. Forms in streams channels and near mountains with coalescing alluvial-fan deposits along lower mountain slopes. Colluvial deposits of angular rock fragments locally on higher mountain slopes.	Moderately to highly permeable but too thin to store significant quantities of water; mostly unsaturated; only thickest deposits may be saturated in lower areas; accepts recharge from snowmelt, transmitting water to underlying hydrogeologic units; this and the underlying older alluvium comprise an aquifer along mountain fronts.
	Older alluvium	Materials ranging in size from clay through boulders, intermixed and interbedded unconsolidated to well cemented. Probably include some lacustrine deposits and colluvium but consist primarily of alluvium. Underlies younger deposits throughout most of region. Grades upward into younger alluvium and lacustrine deposits along valley margins. Interbedded with extrusive igneous rocks in some valleys.	Slightly to highly permeable depending on size and degree of sorting of material and degree of cementation in individual strata. This unit forms the bulk of the valley fill which is the major groundwater reservoir in most valleys.
Cenozoic Tertiary Valley Fill	Igneous rocks	Includes lava flows, ignimbriates, tuffs and braccias mainly in the mountain ranges. Interlayered locally with older alluvium in the subsurface.	Primary permeability generally very low. Where fractured or broken by faulting secondary permeability may be high. Yields water to springs in many areas where fractured. Accepts recharge where fractured and transmits water to adjacent or underlying hydrogeologic units.
Paleozoic Cambrian to Pennsylvanian	Consolidated carbonate rocks undifferentiated	Mainly limestone and dolomite with some shale, siltstone and sandstone. Complexly folded and faulted. Probably underlie most of eastern Nevada and western Utah at depth.	Primary permeability is low. Secondary permeability is moderate to high where solution openings are present, especially along bedding planes, fractures and fault. Most ground-water recharge is absorbed by these rocks where they crop out in the mountains and moves downgradient along bedding planes and fractures to discharge areas. The carbonate rocks probably serve as the principal conduit for groundwater movement in the basins.

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Paleozoic carbonate rocks underlie much of the region to considerable depth as well as cropping out in many mountain ranges. (Kellog, 1963; Marcantel, 1975). These carbonate rocks are primarily limestone and dolomite that hvae been complexly folded and faulted. As a result, the carbonate rocks are capable of transmitting and storing considerable quantities of water within numerous fractures and solution channels. However, the volume of water stored in these carbonate rocks might not be reliably determined because of the indeterminate nature of the passage ways.

The hydrologic significance of the carbonate rocks is primarily related to their volume beneath the surface. In some areas, the thickness of the carbonate rocks is as much as 15,000 feet (Kellog, 1963). A considerable part of the thickness have been found to be conducive to groundwater. Solution channels and cavities have been encountered in oil test wells as deep as 8,000 feet in the Snake Valley, Nevada/Utah (Hood and Rush, 1965). In the same well, fresh water was found as deep as 6,552 feet. Because of this, the carbonate rocks store and transmit considerable quantities of water on a regional basis. Eaking (1966) suggests that the regional transmissibility of the carbonate rocks is about 200,000 gallons per day per foot; a transmissivity of about 27,000 sq. ft. per day. This includes extensive areas of the carbonate rock that has no water-bearing capability as well as the highly localized fracture zones that contain most of the transmitted water.

Extrusive volcanic rocks (i.e., basalt, rhyolite) cover extensive areas of the surface throughout the Great Basin. These volcanic rocks are also found at depth in many of the valleys where they are interbedded with the alluvial sediments comprising the valley fill. As noted in Table 3.2.2.1-2, the water-bearing characteristics of the volcanic (igneous) rocks are similar to those of the carbonate rocks. In effect, the primary porosity and permeability of the volcanic rocks is negligible. Where faulting and fracturing has occurred, however, the volcanic rocks are capable of storing and transmitting water. This water is typically limited to localized zones containing faults and fractures.

The geohydrologic characteristics of volcanic rocks have been examined in detail at the Nevada Test Site in Southern Nevada (Blankennagal and Weir, 1973). The volcanic rocks present at the Test Site are primarily rhyolite lavas and ashflow tuff of Tertiary age. Most groundwater moves through fractures with fractures being common in some flows and absent in others. The results of this study provides an approximation of the water-bearing properties of volcanic rocks in the region.

Based on analysis of drill holes, Blankennagel and Weir (1973) noted that "the combined thickness of intervals with measurable fracture permeability generally ranges from 3 to 10 percent of the total rock section penetrated in the saturated zone." During pump tests, wells produced from 56 to 423 gallons per minutre and transmissivities averaged about 10,000 gallons per day per foot. However, the saturated zone for the test wells used in this study was generally several thousand feet below the surface.

In the project area, groundwater occurs in both unconsolidated (i.e., soils, mine spoils, alluvium) and consolidated (bedrock) units. In the valleys, most recharge is provided by precipitation on mountainous areas, with the water reaching the valleyfill reservoirs by seepage lost from streams on the alluvial slopes and by underflow from the consolidated (bedrock) units. Most of the precipitation evaporates before infiltration, in the mountains and on alluvial slopes, and the remainder adds to the soil moisture, with some reaching lowland areas. In the process, only a very small percentage actually finds its way to the groundwater reservoir. In most valleys in the project area, precipitation quantities are rather small, and infiltration to the groundwater reservoir is generally minimal. Eakin, 1951, Alancy and Katzer, 1975, estimated the potential recharge in the region. The method used in the determinatior assumed that for any given altitude zone, a particular percentage of total precipitation potentially recharges the groundwater reservoir, with that percentage depending on the average amount of precipitation within the zone.

In the project area, movement of the groundwater levels below the ground surface exists and is generally controlled by the topography as well as the thickness and physical composition of the soil cover, while the deep groundwater flow is controlled by the geologic structure and stratigraphic sequence.

In general, groundwater, like surface water, moves from areas of topographic highs toward valleys where the head is lower. In some valleys, groundwater may be discharged to the surface as seeps and springs along valley walls, or directly into stream channels. Sandstone, and siltstone in the alternating layers, may be impermeable and confine the groundwater to isolated lenses within the permeable units. These are known as perched aquifers. In some areas, seepage may cause infiltration of surface water to the subsurface where it remains in the soils because of their low permeability. This does not necessarily reflect a high groundwater level.

Groundwater moves very slowly in most of the valleys, generally at rates ranging from less than one foot to several hundred feet per year, depending on the permeability of the deposits and the hydraulic gradient.

Groundwater movement from one valley to another occurs through both unconsolidated (alluvium soils) and consolidated (bedrock) units. The quantity of interbasin flow is small in relation to the total water supply but it may be a significant part of the hydrologic budget in some valleys. Before significant interbasin flow can occur, two conditions must be met. Consolidated rocks separating the valleys must be permeable enough to transmit appreciable amounts of water and a hydraulic gradient must exist between two valleys. Hydraulic continuity and a gradient may extend across more than two valleys and result in a regional flow system where all or part of the groundwater recharge from several valleys drains to a common sink. Figure 3.2.2.1-3 illustrates regional flow system now known in the Nevada/Utah siting area.

In general, recharge water at the higher elevations moves through the groundwater systems to discharge points at lower elevations. Since a gradient is required to move the water, the water table rises away from the discharge areas. As a result, the water table appears to have the configuration of the subdued topographical areas. The configuration of groundwater flow systems and relationships to topography was investigated in detail by Teth (1962).

The hydrologic system exists in a rather stable state, with the relationship between hydraulic gradient and average hydraulic conductivity adjusted to transport

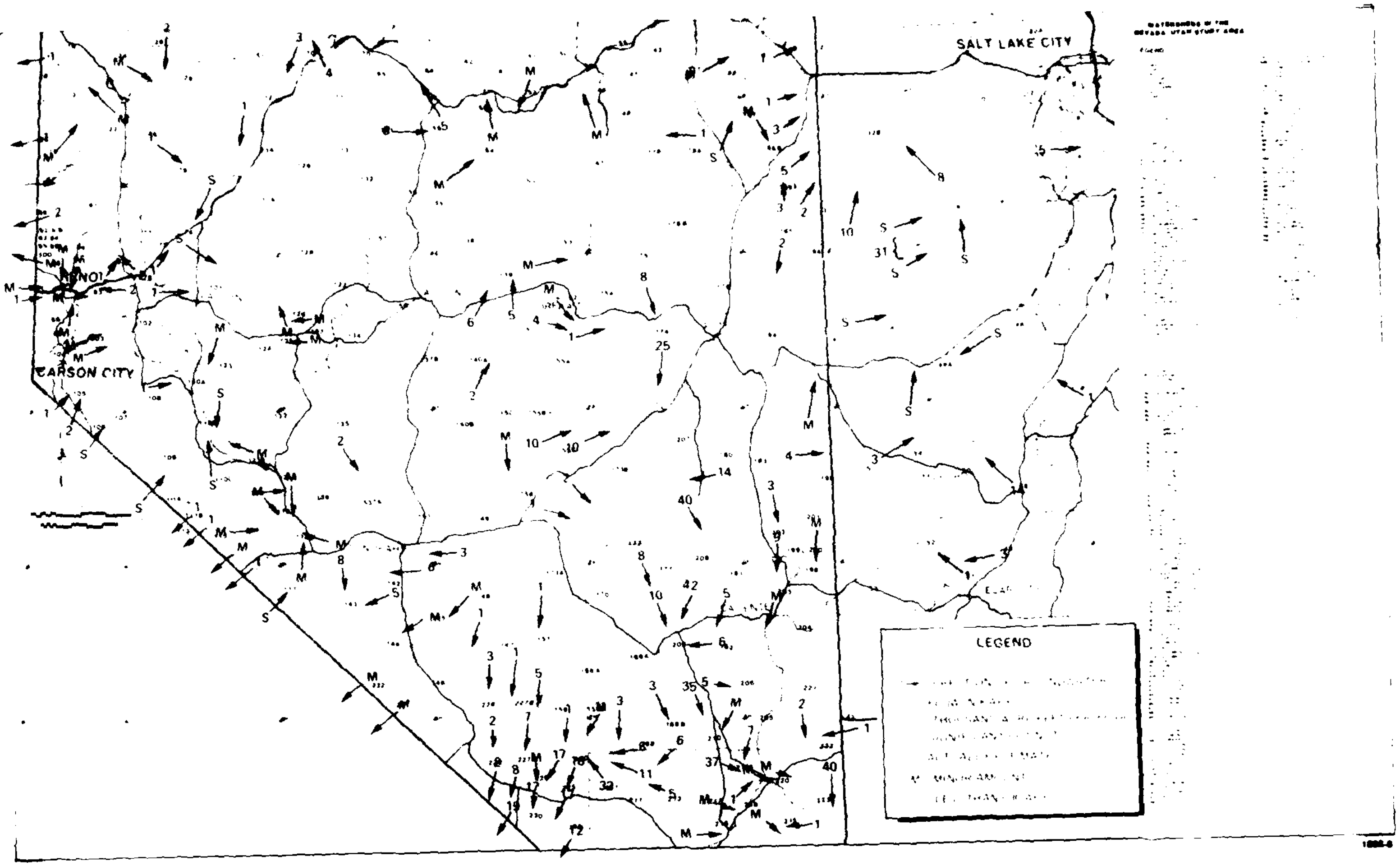


Figure 3.2.2.1-3. Nevada/Utah regional groundwater flow system.

the recharge water from the one location to another. If the recharge is high relative to average hydraulic conductivity, the required transporting hydraulic gradient might become high enough to require the water table to be above the topography. If the recharge water is low, relative to average hydraulic conductivity, the transporting hydraulic gradient may become so low the topographic effect is minimized and the discharge areas shrink in some locations. In arid climates, shrinkage of discharge water areas is accompanied by development of zones of lateral flow where neither discharge nor recharge occurs and the direction of groundwater flow is parallel to the water table.

In the project area, it is assumed that the water table is never above the land surface. The water table is beneath the surface of the ground. However, it may intersect the ground surface at the edges of bodies of water such as lakes, ponds, springs, and rivers. The presence of a sink in the water table indicates that groundwater is flowing toward that particular area. Either water is removed from the sink area or the sink fills. In the steady state processes, a sink would not exist unless some mechanism were available to remove water from the sink as rapidly as it flows toward the sink. Usually water is removed from the sinks in enclosed basins by discharge at the surface. Also, water may move from the existing sink to an underlying aquifer. Generally, surface discharge to maintain a reasonable size sink is common in eastern and northern Nevada.

Wells have been used extensively to produce water for domestic, stock, municipal, industrial, and irrigation purposes. Large capacity pumped wells have accounted for most of the annual withdrawals of groundwater. Individual yields of these wells are as much as 8,600 gpm. The average pumping rate is about 1,000 gpm according to an analysis of 2,000 large capacity wells.

The chemical quality of groundwater in the Great Basin Region ranges from fresh to brine. Generally in sheds and alluvial aprons at the margins of most valleys, the groundwater is fresh. Saline water occurs locally near some thermal springs and in areas where the aquifer includes rocks containing large amounts of soluble salts, such as parts of the Sevier River area. In sink areas, such as the Great Salt Lake, Sevier Lake, and Carson Sink, the dissolved-solids concentrations may exceed that of ocean water.

Groundwater is likely to be the major source of new withdrawals. New technologies for locating water, drilling wells, pumping water, and irrigating fields has resulted in a dramatic increase in groundwater withdrawal in recent decades. Adverse impacts of withdrawal have been minimal, considering the volume of withdrawal which has occurred to date. As a result, groundwater is perceived as the best choice of the three sources for new withdrawals. Long-term impacts of high volume withdrawals are not yet known.

There are areas where groundwater depletions are subject to special regulation. Figure 3.2.2.1-4 shows those hydrologic areas which have been "designated" by the states. Designation means that permits to pump groundwater are: (1) not being issued, (2) being issued with limitations, or (3) being issued for preferred uses only.

The amount of groundwater that can be removed from a basin without causing depletion of the water resource or other associated problems is usually defined by

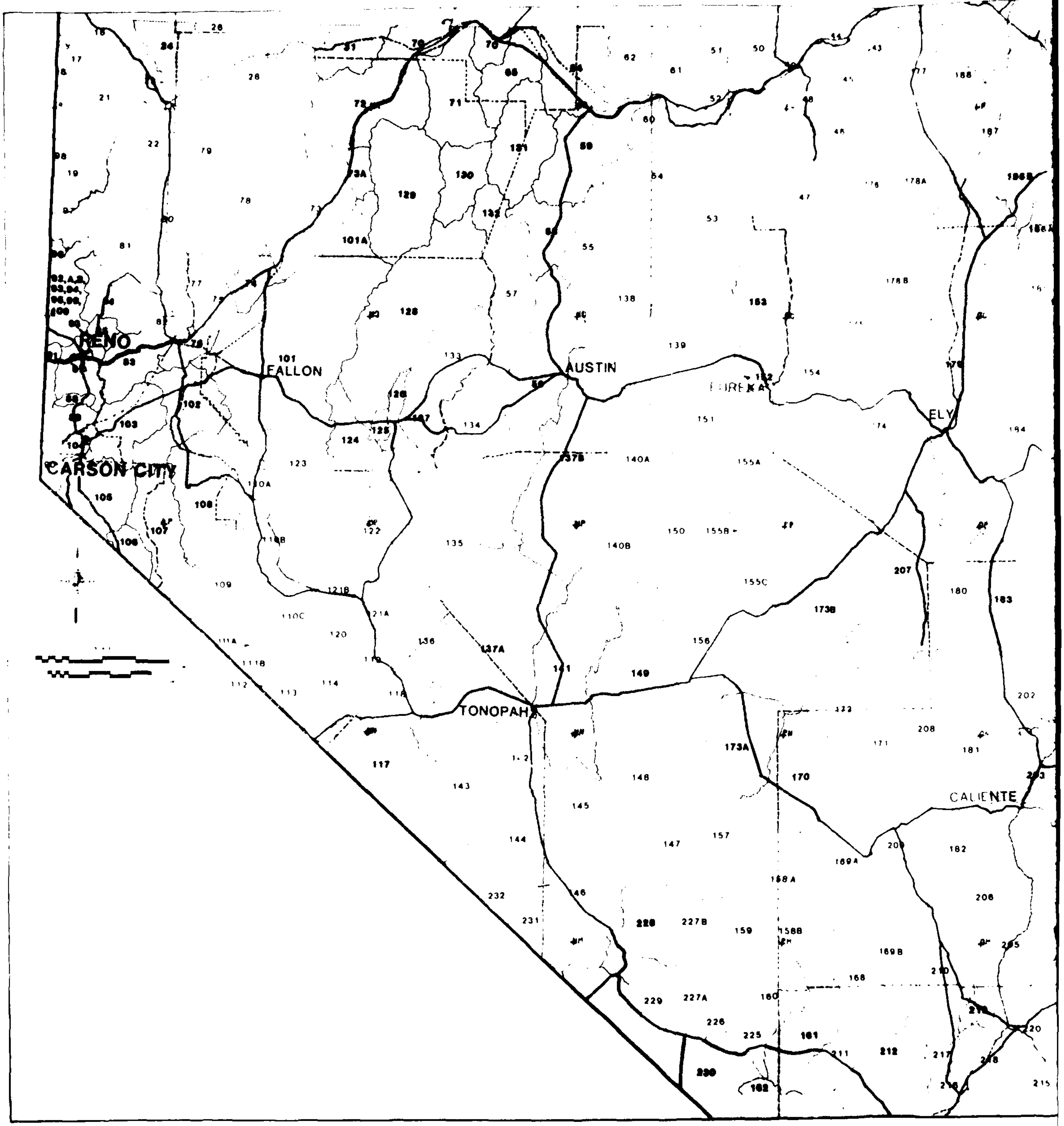
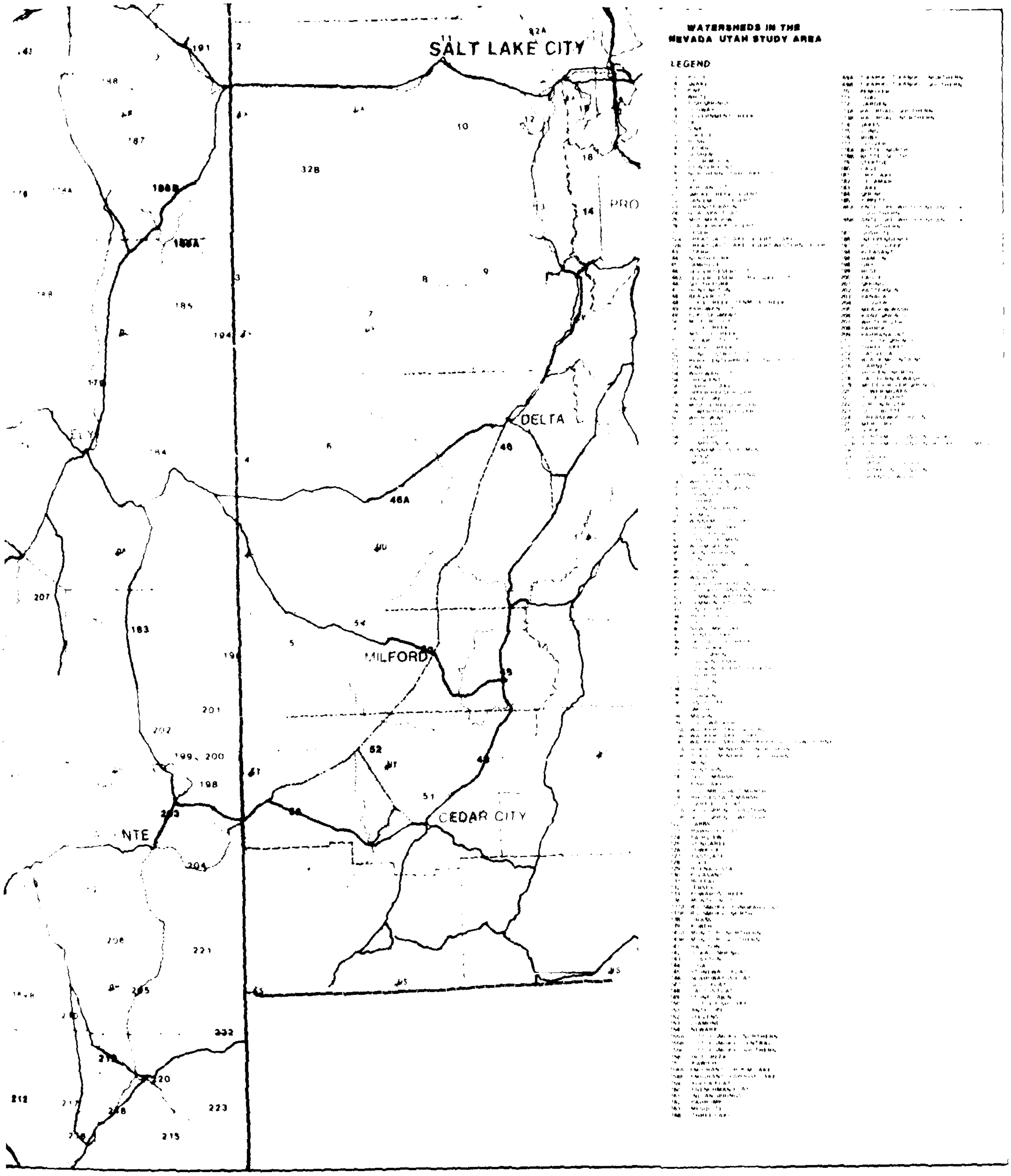


Figure 3.2.2.1-4. Hydrologic areas which hav



hich have been designated by the states.

the perennial yield. Estimates of the perennial yield for each basin have been made by a number of researchers. A compilation of the perennial yield for each valley within the siting area is presented in Table 3.2.2.1-3 in the next subsection.

Water Resources Program (3.2.2.1.1)

The M-X Water Resources Program was initiated in June 1979 for the purpose of evaluating the availability of water for both the construction and operational phases of the M-X project in Nevada and Utah. Six valleys representative of typical hydrologic conditions in the Nevada-Utah siting area were studied during Fiscal Year 1979 (FY 79) ending 30 September, and a report was submitted to the Ballistic Missile Office on 21 December 1979.

Based on the FY 79 studies, it was determined that the Water Resources Field Program should be expanded to include aquifer testing and field investigations in all valleys within the Nevada-Utah siting area in order to better understand the potential effects of M-X groundwater withdrawals on the local water users and the environment and to determine the optimum water supply system for the project.

The Water Resources Program was expanded during Fiscal Year (FY 80) to include field investigations of the hydrologic conditions in 29 valleys to be used for deployment in the Nevada-Utah siting area which includes the six valleys studied during FY 79.

Field hydrologic reconnaissance of 24 of the 29 valleys has been completed to date. Data compilation and the results of the reconnaissance, however, have been completed for 16 of the valleys; the results of studies in these valleys are presented in Section 4.12. Drilling and testing in many of these valleys is in progress and the results of reconnaissance studies will be updated accordingly. The FY 79 and FY 80 study areas in Nevada and Utah are shown in Figure 3.2.2.1-5.

A preliminary literature review of the hydrologic conditions in the Texas-New Mexico siting area was initiated in FY 80. Later detailed investigations are expected.

The primary objectives of the overall Water Resources Program are to:

- Determine the effects of M-X groundwater withdrawals on the local water users, the environment, and the aquifers.
- Determine the optimum water source and supply system with possible supply alternatives for each valley.
- Provide the necessary data and documentation in support of the conclusions and recommendations of the Water Resources Program. The regulatory agencies will require thorough documentation prior to granting permits and permission for water development and use.

The scope of the Water Resources Program includes the following:

- Review of pertinent publications and data contained in agency files relating to water availability, local water use, regional groundwater flow systems, and aquifer characteristics.

Table 3.2.2.1-3. Water availability for M-X affected valleys.

UNIT NO.	HYDROLOGIC UNIT	PERENNIAL YIELD ACRE-FT X [illegible] YR.	STORAGE PER FT IN [illegible] ACRE FT X [illegible]	CURRENT USE ACRE-FT X [illegible] YR	AVAILABILITY ACRE-FT YR.
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	M	
	[illegible]	[illegible]	—	M	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	M	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	6.2	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	None
[illegible]	[illegible] Desert				
[illegible]	[illegible]	[illegible]	[illegible]	250	Overdraft
[illegible]	[illegible]	[illegible]	[illegible]	M	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	None
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	None
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	.3	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Newark	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Little Smoky, North	[illegible]	25	3.3	[illegible]
[illegible]	Little Smoky, South				
[illegible]	[illegible] Creek	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	None
[illegible]	[illegible]	[illegible]	15	M	6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.7
[illegible]	Railroad, South	[illegible]	[illegible]	12.4	[illegible]
[illegible]	Railroad, North				
[illegible]	[illegible]	[illegible]	[illegible]	M	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	M	[illegible]
[illegible]	[illegible], South	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Dry Lake	[illegible]	28	M	[illegible]
[illegible]	Delamar	[illegible]	[illegible]	M	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	None
[illegible]	Spring	[illegible]	42	[illegible]	[illegible]
[illegible]	Hamlin	NA	12	[illegible]	NA
[illegible]	Patterson	[illegible]	—	[illegible]	None
[illegible]	White River	[illegible]	—	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	—	M	[illegible]
[illegible]	Pahranagat	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] Springs	[illegible]	[illegible]	M	[illegible]
179	[illegible]	[illegible]		32	38
[illegible]	Milford	[illegible]	[illegible]	[illegible]	None
[illegible]	Beryl-Enterprise	[illegible]	[illegible]	[illegible]	Overdraft

[illegible]

Footnotes for Table 3.2.2.1-3.

[1]Designated basins refer to areas classified by the Nevada or Utah State Engineer: Office where a permit of application for appropriation must be approved by that office before a well can be drilled. This is usually due to a current state of overdraft or a projected overdraft due to the amount of water use expected from approved applications for appropriation.

[2]Perennial Yield: "The perennial yield of a groundwater system is the upper limit of the amount of water that can be withdrawn economically from the system for an indefinite period of time without causing a permanent and continuing depletion of groundwater in storage and without causing a deterioration of the quality of water. It is limited by the amount of natural discharge of suitable quality that can be salvaged for beneficial use from the groundwater system (Bakin, 1964)."

Perennial yield estimates are abstracted from Reconnaissance Reports published by the State of Nevada or Utah. Where no estimate was given, evapotranspiration is used as an estimate of perennial yield. These perennial yield estimates are used for estimating water availability and are based on the assumption that a decrease in subsurface outflow is unacceptable. A reduction in underflow is a reduction in recharge for the basin which receives that overflow and subsequently reduces the available supply in that area.

Perennial yield estimates are also presented as they appear in figure 5 of the Nevada State Water Plan, Rush, 1974. These estimates are a best-case condition where water could be taken from any one basin but not more than one hydraulically connected basin. As water moves as underflow, it could be removed at any point but then would not be available for downstream users.

[3]Volume of storage is for the top 100 feet of saturated material abstracted from USGS PP 813-G, 1976.

[4]Current use estimates are abstracted from Reconnaissance Reports published by the State of Nevada or Utah and from reports recently prepared by the Desert Research Institute and the Utah Water Research Laboratory for the Air Force.

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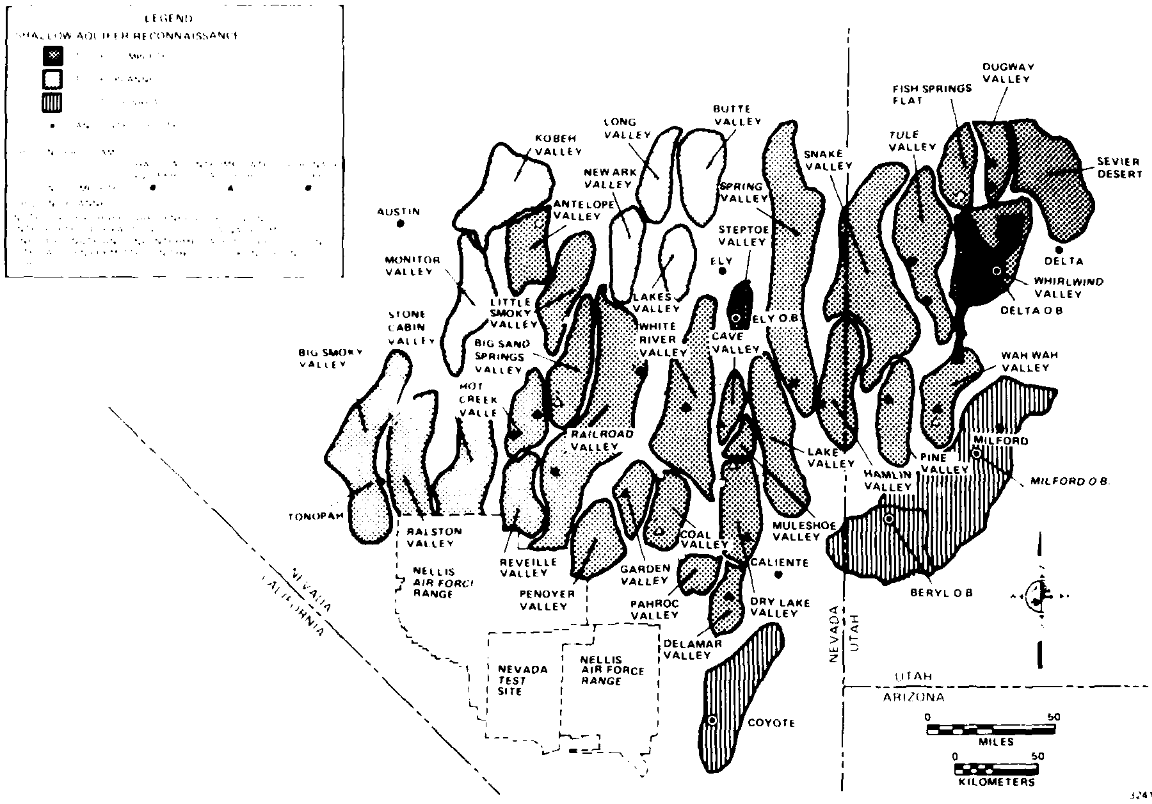

Figure 3.2.2.1-5. Nevada/Utah field program status and scope.

- o Contact various state and federal officials knowledgeable about groundwater conditions in Nevada and Utah.

- o Determination of the amount of water required for construction and operation of the M-X system.

- o Hydrogeologic field studies to identify water users, measure groundwater levels, collect groundwater samples for chemical analyses, measure spring and well discharges, conduct aquifer tests, and overview general hydrogeologic conditions.

- o Drilling and testing of shallow (about 500 ft) and intermediate (about 1,000 ft) valleyfill wells and deep carbonate rock (about 2,500 ft) wells. This work is in progress.

- o Assess municipal water supplies and wastewater treatment facilities for their capacity to handle increases due to M-X population influx. This study included towns within and immediately adjacent to the siting area with emphasis on Tonopah, Ely, Caliente, and Pioche in Nevada, and Delta, Milford, and Cedar City in Utah.

- o Evaluate basin structure to better understand regional groundwater flow systems.

- o Compute numerical modeling simulations of the groundwater system in selected valleys to assess the effects of M-X groundwater withdrawals on local water users and the environment.

- o Industry activity inventory to identify the water requirements of existing and proposed industries in the siting area and how these requirements may interact with M-X construction and operational activities. This study was conducted by the Desert Research Institute for Nevada and the Utah Water Research Laboratory or Utah.

- o Study of Nevada and Utah water laws and permitting procedures and a water rights inventory. This study was conducted by the Desert Research Institute for both Nevada and Utah.

The 16 valleys for which field hydrologic reconnaissances and data compilation have been completed are: (1) Big Smoky, (2) Cave, (3) Delamar, (4) Dry Lake, (5) Dugway, (6) Fish Springs Flat, (7) Little Smoky, (8) Pine, (9) Railroad, (10) Sevier Desert, (11) Snake, (12) Hamlin, (13) Tule, (14) Wah Wah, (15) Whirlwind, and (16) White River. The preliminary results of investigations in these valleys are presented in Section 4.1.2. The location of the valleys studied and the activities performed in each are shown in Figure 3.2.2.1-5 and Table 3.2.2.1-4, respectively. The activity location is identified in the text and appendices according to conventional township-range terminology. An example for Nevada is: 12N/40E-13da which means Township 12 North, Range 40 East, Section 13, Subsection da (NE1/4, SE1/4). A slightly different but similar system is used for Utah and is also included in the report.

Table 3.2.2.1-4. FUGRO National field activities, Nevada/Utah.

AREA	ACTIVITY				
	AQUIFER TEST	WATER QUALITY ANALYSIS	WATER LEVEL MEASUREMENT	DISCHARGE MEASUREMENT	WATER TABLE MONITORING BORING
Big Smoky Valley	2	5	23	2	0
Cave Valley	0	4	8	3	0
Dry Lake Delamar Valley	2	4	2	3	0
Dugway Valley	0	1	3	1	0
Fish Springs Flat	0	2	10	1	0
Little Smoky Valley	0	4	16	4	0
Pine Valley	0	5	1	1	0
Railroad Valley	0	7	5	11	0
Sevier Desert	1	8	21	0	0
Snake Hamlin Valley	9	50	59	38	2
Tule Valley	1	9	17	5	1
Wah Wah Valley	9	1	0	0	0
Whirlwind Valley	0	2	13	2	0
White River Valley	4	21	55	3	1

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Methods of Investigation and Program Status (3.2.2.1.1.1)

Existing Data Study. Collection of existing data has been an ongoing process through all phases of the geotechnical site selection studies conducted by Fugro National. Besides a thorough review of pertinent publications, data have been collected from federal and state agencies, private consultants, petroleum and mining firms, universities, local officials, and private citizens. All information and data collected have been evaluated and, where applicable, incorporated into this report to supplement field work and original data gathering. A survey of existing data was completed in August 1980. This survey was conducted as follows:

- o Identify potential sources of new data by compiling a list of the oil, mining, drilling, and utility companies which operate in the Nevada and Utah siting area; regional libraries as well as libraries, government agencies, and academic institutions within the M-X siting area were also included.

- o Collect available data from the identified sources through purchase.

- o Document all contacts made, the data requested, and the response; this documentation includes both existing and secondary data.

Hydrologic Reconnaissance Study. Field hydrologic reconnaissances of 29 valleys in Nevada and Utah are scheduled for completion by the end of September 1980, and an additional six valleys in Nevada (Jakes, Long, Kobdh, Newark, Monitor, and Butte) will be studied in FY 81 beginning in October 1980. Further explanation of the evaluations and field tests being conducted by Fugro National, the methods of investigation, and the relationship of these tests to overall program objectives are as follows:

- o Aquifer tests are being conducted in selected wells to determine potential well yields and the aquifer's ability to store and transmit water. This information is needed in designing well fields, in evaluating the optimum yield, and in minimizing well interference effects on local water users or springs. Aquifer tests are conducted on existing privately owned and Bureau of Land Management wells, in addition to wells drilled by Fugro National. Testing is performed on large discharge (over 500 gallons per minute) wells where available; however, smaller discharge capacity stock-water wells are also used. Right-of-entry permission is obtained from well owners prior to any aquifer testing.

- o Groundwater levels are being measured in selected wells and drill holes in order to construct potentiometric maps for identifying groundwater migration patterns, identify areas of recharge or discharge, and as an aid in calculating expected pumping lifts for well design. The depth to groundwater below land surface was measured in existing wells and drill holes when accessible, and in wells and borings drilled by Fugro National. Measurements were made using electric water-level sounders or an electro/piezo recorder. Electric sounders indicate depth of water by deflection of a needle on an ammeter when a circuit is closed by contact of an electrode with the water surface. An electro/piezo recorder was used during aquifer test operations on wells developed by Fugro National. The electro/piezo recorder monitors rapid changes in pressure from pressure transducers which are lowered a known depth below the water-level in a well. Relative pressure changes recorded during testing are adjusted for barometric changes and subsequently converted to feet of water-level change relative to the ground surface.

- Groundwater samples are being collected from wells, springs, and streams for analyses to characterize the water quality and assess its suitability for construction or drinking purposes and as an aid in identifying groundwater migration patterns and recharge areas. The water quality analyses include field measurements of the water temperature, pH and specific conductance, and laboratory determination of the concentrations of sodium, potassium, calcium, magnesium, sulfate, chloride, fluoride, nitrate, silica, carbonate, and bicarbonate.

During collection, samples for laboratory analysis are separated into bottles of various sizes and are filtered and/or acidified, depending upon the requirement for testing of the particular suite of ions. After collection, all samples are kept chilled until analysis to further inhibit bacterial production that might change the water chemistry. Water chemistry determinations are done by a qualified testing laboratory.

In addition, certain physical characteristics of the water, i.e., temperature, specific conductance, and pH, are measured in the field at the time of water sample collection and the water also is analyzed for the carbonate and bicarbonate concentrations. At the beginning of each work day in the field, the calibration of the conductivity meter is checked using the meter's internal reference system. The pH meter is calibrated by checking the meter with a buffer solution of known pH prior to each test. Analyses for carbonate and bicarbonate ions are performed using standard titration methods the same day the water samples are collected.

Discharge measurements of springs, streams and flowing wells are being conducted as an aid in determining water availability, for input into computer models to project the effects of M-X groundwater withdrawals and as a baseline data for monitoring systems during construction.

Discharge in combination with water quality can also give insight into the source of springs; regional, valleyfill or meteoric (fed by snow melt and rainfall). Various types of instruments were used to measure spring, stream, and flowing well discharge rates. Current meter and flume measurements were conducted in channel sections that were relatively smooth, straight, and had the least amount of turbulence. Calibrated containers were used to measure the discharge from small wells and from small springs which have been developed by the Bureau of Land Management. In addition to the continuation of field reconnaissance studies, a drilling and testing program was also initiated in FY 1980 to obtain information on aquifer characteristics in valleys where little or no data exists. This program is divided into three parts: a shallow program (about 500 ft), intermediate program (about 1,000 ft), and a deep (carbonate) program (about 2,500 ft). The methodology and purpose of the programs follows.

Shallow (Valley-fill Aquifer) Program

Ten shallow (approximately 500 ft deep) well sets are being drilled in the valleyfill in areas of limited data during FY 80. Each well set consists of one observation well in which piezometers will be installed to monitor the groundwater levels during aquifer testing, and one test well for aquifer testing. The wells are located about 500 ft apart. The ten well sets are scheduled for completion by the end of fiscal year 1980 (September 30). The wells are being drilled in Dugway, Tule, Spring, Hamlin, Railroad, and Hot Creek valleys. Drilling and testing is planned for other valleys in Nevada and Utah in fiscal year 1981.

The general well site locations that have been selected are based upon the following considerations: a) the monitoring of nearby springs, b) assessment of environmental impact on existing water supplies, c) determination of aquifer characteristics, and d) data gap areas.

The well sites are generally located in proximity (one to two mi) to springs or existing wells to test the effects of groundwater withdrawals in addition to the aforementioned considerations. The aquifer testing program consists of a 24-hour continuous step drawdown test, seven days of pumping, and two days of recovery.

Intermediate (Valley-fill Aquifer) Program

The intermediate program was initiated in FY 1980 (Phase I) with the drilling of three observation wells and two test wells in the following valleys:

White River Valley	(observation well) at 8N/61E-27dc
Dry Lake Valley	(observation and test well) at 3S/64E-12ca
Delamar Valley	(observation and test well) at 6S/63E-12da

The observations of the intermediate program was as follows: 1) determine the aquifer characteristics of intermediate depth aquifers in the valleys of the M-X deployment area; 2) where possible, to assess the source and direction of groundwater movement in these aquifers; 3) to evaluate possible aquifer leakage and interconnection with other aquifers, hydrologic boundaries, recharge and discharge areas, and water quality.

Phase II of the fiscal year 1980 intermediate program includes the drilling and testing of four intermediate depth well sets approximately 1,000 ft deep in the valleyfill of four selected valleys. These valleys are Pine, Wah Wah, Cave, and Garden.

The site selection process for these well sets considered the same parameters as listed previously for the Shallow Drilling Program. The four test wells, one in each valley, will be equipped with 10-inch casing and screens. The sites for these four wells (FY 80 Phase II) have been selected primarily as most suitable locations for the achievement of the objectives planned for the intermediate program.

The aquifer testing scheduled for Phase II is similar to that described for the shallow program. Additional drilling and testing in other valleys are planned for fiscal year 1981.

Deep (Carbonate Aquifer) Program

The objectives of the carbonate aquifer exploratory drilling program are to determine the source, occurrence, movement, and hydraulic characteristics of the carbonate aquifer flow system in the White River Valley area, and provide insight into the characteristics of similar regional flow systems in the Nevada-Utah siting area. A minimum of two piezometer wells are planned to be drilled in between White River drainage system by the end of fiscal year 1980. Additional carbonate wells are planned in other areas for fiscal year 1981. The four wells planned during the program will range in depth from 500 to 2,500 ft and will be drilled by rotary and air hammer methods. The borings will be 10 in. in diameter to about 50 ft into bedrock and cased with an 8-in. ID casing. The casing will keep unconsolidated material from dropping into the well during subsequent drilling and will allow a ground seal that can be secured and accrued for later water-level monitoring and water-quality sampling. The remainder of the well will be drilled with a 7 7/8-in. bit until desired aquifers are penetrated or until drilling cannot be continued due to circulation loss. If circulation is lost, a 6-in. liner will be lowered through the loss circulation zone and drilling will continue with a 5-5/8-in. bit to completion. Upon completion, the 6-in. liner will be withdrawn.

Aquifer testing will be conducted for up to 30 days in two of four wells at the highest rate of pumping withdrawal possible for the given well construction and pumping lifts.

Evaluation of data will entail reduction of aquifer test data, compilation of water quality and water level data, and incorporation of all data into the overall water resources investigation. For the carbonate aquifer investigation, water level data will be plotted on regional cross-sections and then correlated with water levels within the intervening valleys. This approach will provide further understanding of the interrelationship between the valleyfill and carbonate (regional) aquifers. Final technical graphics will include regional geologic maps, cross sections, geologic logs, and potentiometric maps of carbonate and valleyfill aquifers.

Operating Base-Site Studies

Detailed operating base field studies will be conducted for the Ely, Delta, Milford, Beryl, and Coyote/Kane Springs sites in fiscal year 1981. These studies will be "tailored" to the availability of water in each basin. For example, in the Ely area, Steptoe Valley is a designated groundwater basin. Additional appropriations may be allowed if sufficient data can be provided to demonstrate development of additional water supplies will not seriously impact current water users. There is also a potential for development of the carbonate aquifer. The Beryl, Utah area is a closed groundwater basin, no further long-term appropriations will be allowed by the State Engineer's Office, and there is no clear potential for development of carbonate aquifers. The general purpose of the operating base investigations is to:

1. Clarify the potential impacts on the nearby groundwater users and the environment resulting from groundwater extraction for M-X use; assuming that either additional water can be appropriated or existing water rights could be purchased and the points of diversion relocated near the operating base site.

2. Determine the interrelationship of various groundwater aquifers in the area.

3. Identify and confirm the viability of alternative groundwater sources of supply.

4. Make recommendations as to the water supply alternatives and the course of action to obtain water for the operational base.

To make these determinations, a program of hydrologic reconnaissance of existing water resource utilization and conditions will be conducted concurrently with drilling programs. The reconnaissance will be similar in nature to that performed in the FY 79 and FY 80 programs. Drilling will consist of constructing test/production and observation/monitoring wells in the valleyfill and/or carbonate aquifer near each basing location. One to three well sets ranging in depth from 400 to 1,000 ft below ground surface will be drilled in the valleyfill aquifer in proximity to each proposed base location. The design, construction, and testing of these wells will be similar to those in the FY 80 and 81 regional studies. One or two deep (2,500 ft) carbonate test/production wells will be constructed near OB sites that have potential for carbonate aquifer development (Ely, Coyote/Kane Springs, Milford). The wells will be similar in design, although larger in diameter, to those in the Drilling and Testing Program section of this report.

Basin Structure Study

A general geologic structure study of the Nevada/Utah siting area was conducted during FY 80 for input of general basin configuration to the computer modeling, and to determine the general occurrence, thickness and stratigraphic relationship of carbonate rock formations which have the potential to store or transport water. This study, although not complete, was utilized in locating deep drilling and testing sites and will be used in predicting the path and mechanism of intervalley flow systems. This study will continue to be updated and will be useful to the water management plan in selecting areas of potential carbonate aquifer development.

Computer Numerical Modelling

The computer numerical modeling techniques have been used on selected valleys in an effort to gain the best possible understanding of the groundwater flow systems, and with the intent that the models, when calibrated and verified, will be useful as management tools when water withdrawals begin for construction. The model chosen for this task is the Trescott, Pinder, Larson finite difference model as published by the U.S. Geologic Survey (Trescott, Pinder, Larson, 1976). This model was chosen because of its ready availability, its proven reliability and acceptance by the hydrologic community, and availability of the documentation and assistance from the U.S. Geologic Survey. Ten valleys have been selected for modeling by this technique. The choice of valleys was based on the availability of data on aquifer properties and water budgets and on whether M-X-related water use will be in competition with other users or whether water is in short supply. Of the ten valleys selected, four have been completed. They are Snake, White River, Dry Lake, and Muleshoe valleys.

The valleys for which modeling is yet to be completed are Hamlin, Railroad, Pine, Wah Wah, Delamar, and Tule. Snake, Hamlin, White River, and Railroad were selected because of the relatively extensive development of groundwater resources for agriculture and consequently the relatively good data available on the aquifers. Dry Lake, Delamar and Muleshoe were chosen because of the short supply of water and the information gathered from drilling and testing two wells as part of the

Intermediate Drilling and Testing Program. Pine, Wah Wah, and Tule valleys were selected because the available data, although sparse, is better than that from some of the other valleys in the study area. Tule Valley is also being studied in the Shallow Drilling and Testing Program, which will provide additional data.

It was originally planned to model Dry Lake, Delamar, and Muleshoe valleys as one hydrologically linked system. However, geologic and geophysical evidence, plus difficulty in calibrating the model led to the conclusion that Dry Lake is not well connected hydraulically to Delamar Valley, and they are therefore being modeled separately. In Snake and White River valleys there is a significant amount of irrigation and the aquifers are relatively well developed; however, the data are relatively meager. For example, in Snake Valley only five aquifer drawdown tests could be performed and four of these tests were located close to each other. Therefore, geologic interpretations rather than field test data are largely the basis of the input parameters such as transmissivity and storage coefficient.

The numerical simulations were performed with a range of transmissivities and storage coefficients, in order to bracket the actual field conditions. The results included in this volume are based on the most reasonable input parameters.

The transmissivities believed to be most reasonable are on the order or 5,000 gpd/ft in high transmissivity areas such as in thick fan sequences where the formation is relatively thick and permeable. These values are based on field testing by FNI, examination and interpretation of base hold logs, and stratigraphic and structural interpretations. The storage coefficient believed to be most reasonable is 0.1. This is a typical value for an unconfined aquifer of granular material. Even though some of the aquifer drawdown tests indicated much lower values for the storage coefficient, in the range typical of artesian aquifers, it is believed that the water resource developed for the M-X system will be from unconfined aquifers. The low values of storage coefficient can be explained by the fact that the tests, although conducted up to 10 days, were not run long enough to enter the nonelastic, gravity drainage part of the test in these thick aquifers. The simulations of drawdown due to M-X-related withdrawals are based on a pumping period of two years as this is believed to be the length of time required for construction of shelters. The Snake Valley model was the first model completed. It was done at a time when it was believed that 5 years was a likely construction period, and the simulation was therefore run for that time. Lesser time periods would result in slightly smaller drawdown values.

Municipal Water Supply, Water Level, and Wastewater-Treatment System Studies

Studies of the existing municipal water demand, potential supply, and impact of future growth on both water supply and sewage transmission and treatment facilities were initiated for the Nevada/Utah siting area late in calendar year 1979. The studies were conducted by the Desert Research Institute (DRI) for towns within or near the potential M-X siting area in Nevada, and by the Utah Water Research Laboratory (UWRL) for towns within or near the siting area in Utah. These studies were conducted to define the potential effects of M-X-related population growth on existing water supply and wastewater-treatment facilities and included the following:

- An assessment of the existing municipal water resources and the impacts of increased water use on Tonopah, Ely, Caliente and Pioche, Nevada, and Delta, Milford and Cedar City, Utah, including the identification of each municipality's source of water, the quantity present, and the amount of present usage.

- o Determination of the ability of the water supply and sewage systems to accommodate increased usage, the maximum capacity for increase without modification of the system, and the economics of an increase if modification is required.

- o Evaluation of the water quality limitations of the water supply system.

- o Recommendation of the necessary water supply and wastewater treatment facility improvements required by increased usage.

- o An overview of the effects of increased water usage in small towns such as Baker, Lund, Preston, Alamo, Panaca, Garrison, and others that lie within or at the margins of the Nevada-Utah siting area.

The studies, which were completed by early Summer 1980, were based upon recent water system planning reports by private consultants and state and federal agencies, supplemented by communication with community officials. Available information on the design criteria, and population projections were also utilized.

Industrial Activity Inventory Studies

An Industry Activity Inventory Study covering the area within and near the potential Nevada/Utah siting area was initiated late in calendar year 1979. The work was conducted by the Desert Research Institute DRI for the Nevada siting area and by the Utah Water Research Laborator UWRL for the Utah siting area. The inventories were conducted because large scale industrial, commercial, or mining projects in the M-X siting region could create substantial and sometimes subtle interaction with the proposed missile complex. Together, these studies provide a basis for joint consideration of how best to meet the water supply needs for the M-X missile system in the most optimal way with consideration of other future users. To accomplish this task the studies included the following:

- o Inventory of existing and proposed major industrial, mining, grazing, energy extraction, energy transporting, energy producing activities.

- o General assessment of present and future water requirements for enterprises in the region including estimates of location and timing of need with respect to most likely sources of supply. The inventory included but was not limited to, the following: coal mining industry, nuclear power plants, solar power projects, geothermal explorations, thermal electric generation, coal slurry transport, mining, grazing, agricultural, and recreation requirements. Water quality dimension of the problem also addressed.

- o Identify the potential water transfer possibilities amongst the industries, and other water-use interactions within the region with reference to conflicts such as land use and environmental aspects.

The studies were completed in the summer of 1980, and included only pertinent projects beyond their preliminary planning stage. All available information from Fugro National, respective state and federal agencies and individual private companies was utilized.

Water Management Plan

A design of a water management plan will be made for each valley for the construction and operational phases of the M-X project. The water management plan will include preliminary recommendations for:

- Source of water supplies and alternatives for each valley;
- Well field design for construction and operation;
- Spring discharge and water level monitoring systems before, during, and after construction;
- Computer models of the groundwater system for evaluation of the effects of water level or spring discharge changes detected during monitoring; and
- Wastewater treatment facilities that should be employed.

Water Law (3.2.2.1.2)

Development and management of water is generally under the jurisdiction of the states, since there are no federal statutes governing water rights. The states impose regulations based on a combination of two basic doctrines: the appropriation right and the riparian right. Federal reserved rights are also discussed in this summary.

The Appropriation Right

The appropriation right was developed in the western states since 1845 in response to the unique hydrologic character of that area. An appropriation is made when a person takes water from some source and applies it to some beneficial use. The ranking of rights is according to "first in time, first in right." That is, the earliest appropriation will be the last one required to curtail use if a shortage occurs.

Under this doctrine, the right to use water is independent of the ownership of land. Appropriation is limited to the amount reasonably needed for a beneficial use. Beneficial use is broadly defined and may include mining, manufacturing, agriculture, municipal, and culinary. The water right, under appropriation, can be traded or sold. It is possible to lose the right through non-use or abandonment.

The Riparian Right

The riparian right is a water right attached to and inseparable from a parcel of land which is bounded by or traversed by a natural water course. By extension, riparian rights apply to groundwater lying beneath the land in question. A riparian proprietor has the right to the flow of the stream, undiminished in quality and quantity from a state of nature, except as affected by reasonable use by other proprietors. A riparian system typically has the following characteristics: a) rights to the use of water are created by ownership of land which is riparian to the water; b) the water right is a part of the ownership of the land and cannot be lost by non-use; and c) the riparian owner may use the water only on the riparian tract of land and may not sell it or use it himself off of that tract.

Federal Reserved Rights

Federal reserved rights are based on two clauses of the Constitution: Article I, Section 8, "Congress shall have the power to regulate commerce with foreign nations, and among the several states, and with the Indian Tribes," and Article IV, Section 3, "The Congress shall have the power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States." These are, respectively, the commerce clause and the property clause of the Constitution. The commerce clause is the source of federal water rights on navigable streams, and the property clause is one of the sources of the federal water rights that is applied to Indian reservations and other land which has been reserved for some federal purpose or otherwise withdrawn from public acquisition. The federal water right obtained under the property clause is inferior to the rights of state prior appropriators existing at the time that the federal reservation is made.

Overview of Nevada and Utah Water Laws

In both Nevada and Utah, the basic water law is the doctrine of prior appropriation for beneficial use.

In Nevada, the only requirement that must be satisfied for the appropriation of groundwater are: 1) unappropriated water available, 2) a recognized beneficial use, and 3) no interference with existing rights. The state engineer can be expected to take into consideration lowering of water levels at nearby wells in determining availability, while considering the average annual replenishment rate.

In Utah, the state engineer shall approve an application for appropriation if 1) there is unappropriated water available, 2) the proposed use will not impair existing rights or interfere with a more beneficial use of the water, 3) the proposed use is physically and economically feasible, 4) the applicant has the ability to complete the plan, and 5) the application is filed in good faith and not for the purpose of speculation.

Statute law in both states gives the state engineers discretion in approving applications. Decisions of the state engineers can be appealed to the courts in both states.

Process For Obtaining Permits to Appropriate Water

Permits to appropriate water in Nevada and Utah require information on the applicant and enough information on the source of water, type of construction, and use to enable the state engineer to make an informed decision on approval of the appropriation. Required information includes name and address of applicant, source and amount of water, location and cost of works, purpose, and time frame for construction and use. Hydrologic information is not required but may be needed if a protest is filed.

In both states the process for appropriating water is quite similar. The procedure is charted in Tables 3.2.2.1-5 and 3.2.2.1-6. The applicant must first file an application to appropriate, after which the state engineer publishes a notice in the local newspapers (published five consecutive weeks in Nevada and three weeks in Utah). After the date of the last publication, interested parties have 30 days, in both states, in which to file a protest. The state engineer may then approve or disapprove the application based on availability of water and the merit of the protests. This usually takes about 30 days in both states. Any decision by the state engineer is subject to appeal and review by the state court system, ultimately to the State Supreme Court.

Surface Water (3.2.2.2)

Surface water sources in the siting area include lakes, reservoirs, rivers, streams, and springs. These may be fed by precipitation or discharge from the groundwater system. There also exists a largely unused quantity of sewage.

Numerous springs are located within the siting area. These springs support streamflow and the larger ones may be used for irrigation. Generally, ditches are used to divert water for application in nearby fields. A portion of the spring flow is lost to evaporation and transpiration. A relatively small quantity of the water use for irrigation seeps back into the ground and percolates to the groundwater reservoir.

Thermal mineralized springs are scattered throughout the state and are generally located near faults. To date, geothermal energy resources have been used for heating houses, domestic water supplies, swimming pools and mineral baths, and the heating systems of green houses.

The siting area in Nevada and Utah is characterized by many closed basins and numerous mountain ranges. These mountain ranges are roughly parallel in a north-south direction and are separated by alluvium-filled basins. There is an abrupt change of slope at the base of the mountains between mountain fronts and alluvial aprons. These aprons consist mainly of gently sloping fans built up by erosional debris from the mountains. Numerous small streams originate in the mountains and are usually perennial until they reach the mountain front. The streams then diverge into numerous distributory channels where they flow upon the aprons. At this point most of the stream flow is lost by infiltration into the ground, by evaporation, and by transpiration. Thus, many streams are perennial in their headwaters and ephemeral in their lower reaches.

Streamflow data for the major rivers in the area are shown in Table 3.2.2.2-1. The gauging stations shown are the furthest downstream for each river. Losses from diversions, from evapotranspiration, and percolation to groundwater will have occurred. Thus, this data should represent the net flow for each river. Variability in stream discharge results from climate and topographic influences within the region. A comparison of the Bear River in Utah and the Muddy River in Nevada

Table 3.2.2.1-5. Sequence of actions for obtaining a water right in Nevada. (Page 1 of 2)

STEP	PERSON(S)	ACTION	FORM REQUIRED	TIME	FEE	COMMENTS
1	Applicant	File "Application for Permit to Appropriate Water"	N-1 Nevada Form No. 2888 (Rev.11-72)	60 days for action to correct application	$35.00	A map by a licensed State Water Rights Surveyor must be filed with the application or within 60 days of notice. Otherwise the application is cancelled. See step 11 for alternate action.
2	State Engineer	Publish notice in newspaper	—	30 days from	—	Published once a week for 5 consecutive weeks in local newspaper.
3	Public	File protest with State Engineer	—	30 days from last publication	—	Formal protests must be filed within this time.
4	State Engineer	Field investigation	—	30 days (variable)	—	Investigate the site and check protests—may reject proposal after field investigations. Applicant may appeal State Engineer's rejection in District Court.
5	State Engineer	Approve or reject application	—	1 year from final protest; may be postponed	$10.00/cfs ($10 min.)	State Engineer gives time limit for starting and finishing construction. See step 10.
6	Applicant	Proof of commencement of work	N-2 Nevada Form No. 259	Time limit set by State Engineer	$ 1.00	The applicant starts the required work for diversion of water or drilling a well.

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Table 3.2.2.1-5. Sequence of actions for obtaining a water right in Nevada. (Page 2 of 2)

STEP	PERSON(S)	ACTION	FORM REQUIRED	TIME	FEE	COMMENTS
7	Applicant	Proof of completion of work	N-3 Nevada Form No. 260	Construction time within 5 years: varies	$ 1.00	Filed after the work is finished and water is ready to be diverted.
8	Applicant	Proof of beneficial	N-4 Nevada Form	Not over 10 years; set by State Engineer	$ 1.00	Specifies the use of the water and the amount actually applied to a beneficial use. A map by a Water Rights Surveyor is required.
OTHER FORMS						
10	Applicant	Application for time extension	N-5 Nevada Form No. 401	—	$ 5.00	To get an extension of time for construction of the project.
11	Applicant	Application to change point of diversion, manner, or place of use	N-5	—	$40.00	This form is needed to change point of diversion, the manner or place of use of the water. This would be in lieu of Form 1 in step 1; steps 2 through 9 must be followed.

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Table 3.2.2.1-6. Sequence of actions for obtaining a water right in Utah (Page 1 of 2).

STEP	PERSON(S)	ACTION	FORM REQUIRED	TIME	FEE	COMMENTS
1	Applicant	File "Application to Appropriate Water"	U-1 Utah Form 97 2M 10-70	Variable, about 60 days for action	$15.00 min. to $150.00 plus $7.50/cfs above first cfs	For alternate actions: purchase (see step 8) or lease (see step 9) of existing water rights.
2	State	Publish notice in newspapers	—	3 weeks	—	
3	Public	File protests with State Engineer	—	30 days	—	Protests must be filed within 30 days after last publication of notice in newspapers.
4	State Engineer	Field investigation	—	30 days (variable)	—	Investigates protests and checks availability of water and feasibility of project. Applicant may appeal to district court should application be rejected (60 days time limit).
5	State Engineer	Approve application	—	—	—	State Engineer sets time limits to start and finish construction (see step 6)
6	Applicant	Proof of Appropriation form	U-2 Utah Form No. 49	After construction is completed	—	Prepared by Registered Engineer or Licensed Land Surveyor. Maps and drawings and surveys required.

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Table 3.2.2.1-6. Sequence of actions for obtaining a water right in Utah, (Page 2 of 2).

STEP	PERSON(S)	ACTION	FORM REQUIRED	TIME	FEE	COMMENTS
7	State Engineer	Issue Certificate of Appropriation	—	About 60 days	—	
8	Applicant	Application for change in use	U-3 Utah Form No. 107 3066	Variable, about 60 days for action	See step 1	Purchase of water rights. Followed by steps 2-7 or lease for more than one year.
9	Applicant	Application for change in use	U-4 Utah Form 1118-61-2 M	Variable, about 60 days for action	$5.00 plus costs	Lease or rental change in use and/or point of diversion for one year or less.
10	Applicant	Proof of change of	U-5 Form 58	After construction is complete	—	See step 6, comments.

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Table 3.2.2.2-1. Flow characteristics of major rivers in the Nevada/Utah study area.

RIVER	DRAINAGE AREA MI²	YEARS OF RECORD	PERIOD	AVERAGE DISCHARGE FT³/S	EXTREMES		ANNUAL DISCHARGE THOUSANDS OF ACRE FT. PER YEAR
					MAXIMUM FT³/S	MINIMUM FT³/S	
Utah[1]							
Bear River [illegible]	7,0[illegible]	–	1973-1978	2,16[illegible]	[illegible],90[illegible]	240	1,56[illegible]
Weber River [illegible]	[illegible],06[illegible]	74	1966-1978	48[illegible]	[illegible],10[illegible]	19	347.[illegible]
Jourdan River [illegible]	[illegible],435	35+	1943-1978	141	384	69	[illegible]
Sevier River [illegible]	[illegible],96[illegible]	36+	1942-197[illegible]	18[illegible]	[illegible],98[illegible]	[illegible]	134.6
Nevada[2]							
Muddy River 0941900[illegible]	6,78[illegible]	28+	1950-1978	45.5	7,360	7.6	32.[illegible]
Walker River 10301600	2,70[illegible]	2	1977-1978	31.7	49[illegible]	0	—
Carson River 10312280	1,95[illegible]+	11	1967-1978	37.9	1,030	0	27.4
Humboldt River 10335000	16,10[illegible]	35+	1899-1978	204	4,420	0	147.8
Truckee River 1035170[illegible]	1,81[illegible]	21	1957-1978	439	14,400	5.1	318.4

15 [illegible]

[1] U.S. Geological Survey, Water Resources Data for Utah, USGS Water Data Report UT-78-1, 1979.

[2] U.S. Geological Survey, Water Resources Data for Nevada, USGS Water Data Report NV-78-1, 1979.

show that they have similarly sized drainage basins. Average discharge from the Bear River, however, is almost 50 times greater than the Muddy River. This occurs primarily because the headwaters of the Bear River are within the Rocky Mountains where precipitation is considerably higher than that which occurs in the mountain ranges of Nevada. Stream flow in different areas will also be affected by variations in both cultural (i.e., irrigation, municipal uses) and physical (i.e., evaporation, transpiration, subsurface flow) factors.

Streamflow in the region exhibits extreme variability with time. For the large perennial rivers, variation in flow is associated with seasonal changes in precipitation and temperature. Melted water from snow in mountainous areas is the major source of water for those rivers. This is reflected in the extreme flow category in Table 3.2.2.2-1. For example, the maximum recorded flow (490 cfs) for Walker River occurred during the middle of April 1978, the minimum flow (0 cfs) during July 1977 (USGS, Water Data Report NV-78-1, p. 141). Streamflow in the area is also associated with extreme variations in weather. Heavy rainfall or cloudbursts will produce high flows; conversely, extended periods of drought will result in minimum flows.

In addition to the large perennial streams, the area has thousands of streams which are ephemeral throughout their reaches. These streams usually have short periods of very high rates of runoff, resulting from high-intensity storms or cloudbursts, separated by long periods of little or no flow. Due to their erratic runoff characteristics, the surface water in the ephemeral streams can be economically impounded only in small stock and irrigation reservoirs for limited use. However, as a source of recharge to the groundwater system it is quite significant.

The estimated total annual flow of a number of small streams in selected valleys in central Nevada is shown in Table 3.2.2.2-2. An average of about four secondary steams (annual flow greater than 1,000 acre-feet) and five minor streams (annual flow less than 1,000 acre-feet) are present in a valley. This would provide an average of about 19,000 acre-feet per year of surface water to a typical valley. However, much of this surface water is probably lost to evapotranspiration or serves as groundwater recharge. Table 3.2.2.2-3 shows actual flow characteristics for several streams. Average discharges range from 0.115 cfs to 8.85 cfs, and some streams have no water during the summer months. Similar streams would have to be evaluated almost individually to determine whether or not they could provide a dependable supply of surface water.

Except for lakes in terminal sinks, most water is in transient storage. Water may be in transit to sinks for several weeks from the effects of channel storage or overbank flooding. Small ponds, lakes, or similar impoundments may delay the flow a few days or so. As the volume of available storage increases, containment of water often extends from several weeks to several years for the larger reservoirs and lakes. Numerous lakes and reservoirs provide storage within the Great Basin Region. The lake and reservoir maps presented in Figure 3.2.2.2-1 show locations of lakes and existing or potential reservoir sites.

The term 'wetlands' refers to those areas which are inundated by surface or groundwater with sufficient regularity to support vegetative or aquatic life that requires saturated soil conditions for growth and reproduction. Two of the major wetland areas are briefly described below:

Table 3.2.2.2-2. Estimated average annual flow of small streams in selected valleys in central Nevada.

VALLEY	SECONDARY STREAMS[1]		MINOR STREAMS[2]	
	NUMBER OF STREAMS	ESTIMATED AVERAGE ANNUAL FLOW (acre feet/yr)	NUMBER OF STREAMS	ESTIMATED AVERAGE ANNUAL FLOW (acre feet/yr)
Big Smoky	5	19,000	14	10,000
Butte	2	3,000	2	2,000
Little Smoky	1	3,000	—	—
Newark	2	4,000	2	2,000
Railroad	1	6,000	3	1,000
Ralston	—	—	3	2,000
Spring	11	40,000	10	10,000
Steptoe	6	35,000	5	5,000
TOTAL	28	110,000	39	32,000

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[1]Annual flow for each stream is more than 1,000 acre feet.

[2]Annual flow for each stream is less than 1,000 acre feet.

Source: Pacific Southwest Inter-Agency Committee Water Resources Council (1971), *Great Basin Region - Comprehensive Framework Study, Appendix V, p. 30.*

Table 3.2.2.2-3. Flow characteristics of small streams in selected valleys in central Nevada.

VALLEY	STREAM NAME STATION NO.	DRAINAGE AREA		AVERAGE DISCHARGE		EXTREMES				ANNUAL DISCHARGE
						MAXIMUM		MINIMUM		
		(mi^2)	(km^2)	(cfs)	(m^3/s)	(cfs)	(m^3/s)	(cfs)	(m^3/s)	(acre feet)
Big Smoky	Kingston Creek 10249280	23.4	60.6	8.37	0.23[illegible]	150	4.25	1.4	0.04	6,060
Little Smoky	Tributary Stream 10245800	157	407	0.115	0.0032	239	6.74	0	0	83
Railroad	Little Currant Creek 10246846	12.9	33.4	3.2	0.09	366	10.4	0	0	2,320
Steptoe	Steptoe Creek 10244950	11.1	28.7	8.85	0.25	37	1.05	2.0	0.06	4,990

1502

SOURCE: USGS Water Data Report NT-78-1, p 87-100.

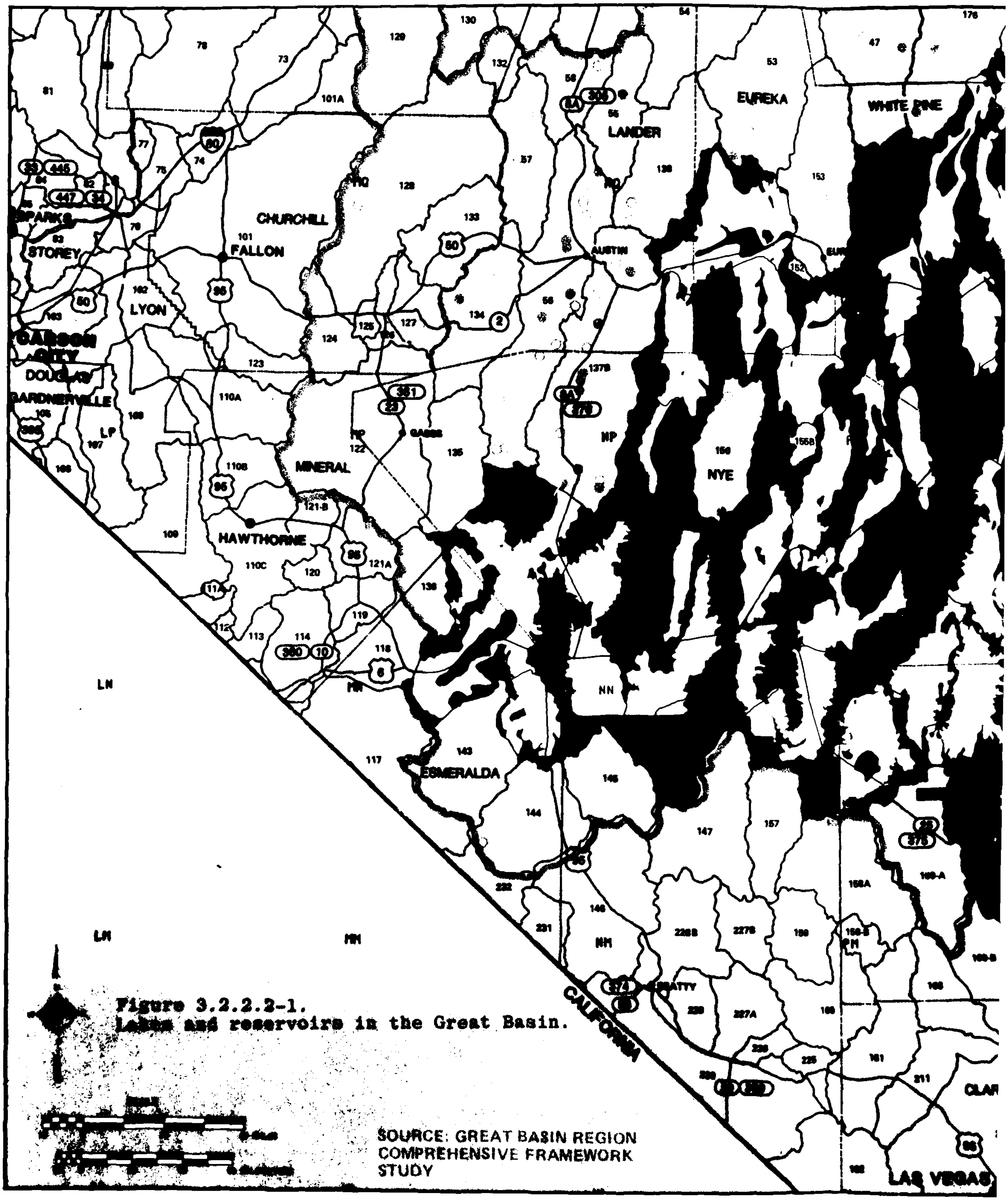
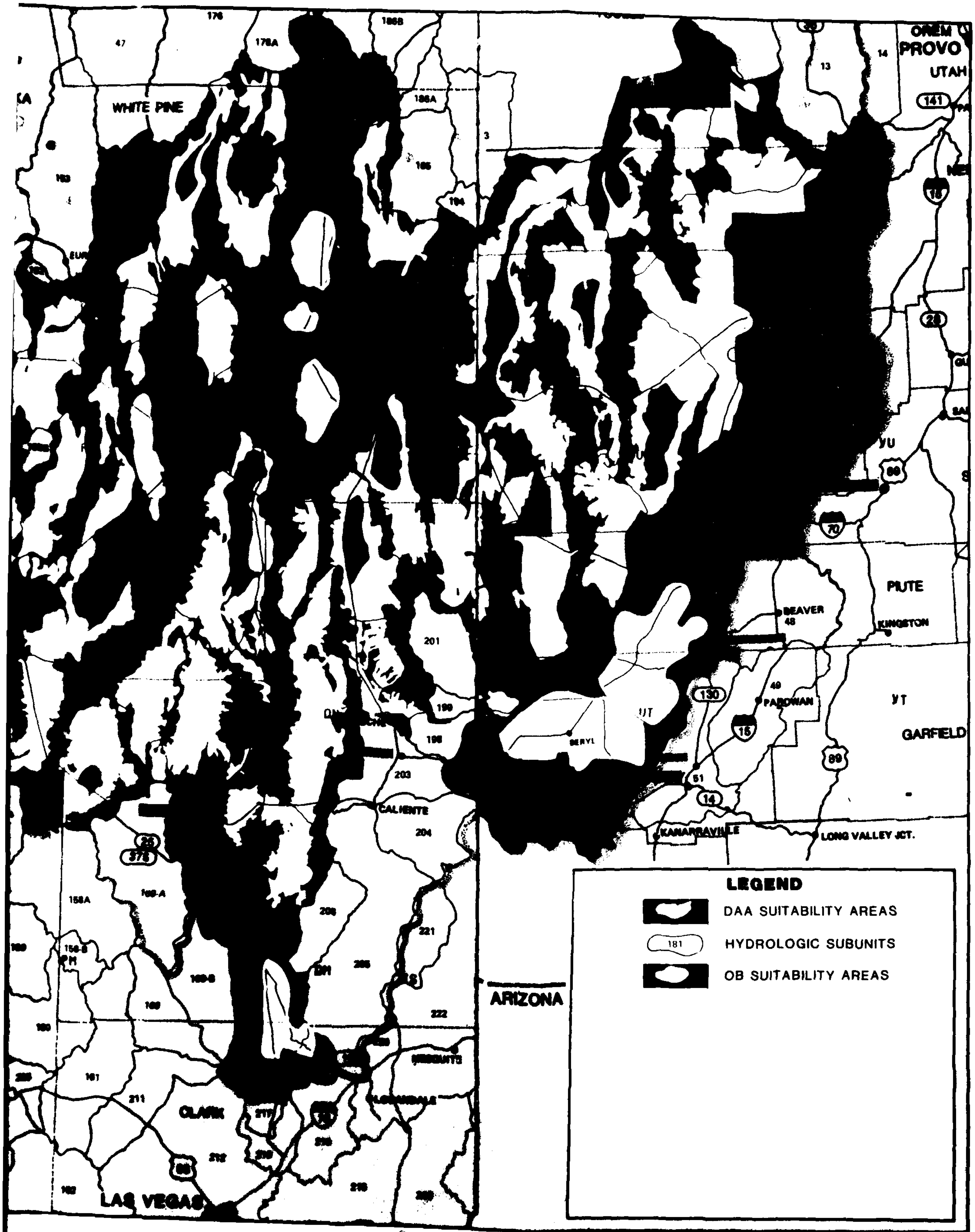


Figure 3.2.2.2-1.
Lakes and reservoirs in the Great Basin.


LEGEND
DAA SUITABILITY AREAS
181
HYDROLOGIC SUBUNITS
OB SUITABILITY AREAS
WHITE PINE
PROVO
UTAH
PIUTE
BEAVER
KINGSTON
PAROWAN
GARFIELD
BERYL
CALIENTE
KANARRAVILLE
LONG VALLEY JCT.
ARIZONA
CLARK
LAS VEGAS
176
47
178A
186B
186A
13
14
141
185
184
15
70
89
201
199
198
203
204
205
206
221
222
130
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158A
161
211
212
217

2

3222-D

- o The bed of the pluvial White River, which is now dry for much of its course, has several wetland areas located in the Pahranagat and White River valleys. The wetlands in Pahranagat Valley are basically fed from Ash, Crystal, and Hiko springs. These thermal springs feed the Key Pittman Wildlife Management Area and upper and lower Pahranagat lakes.

- o In Fish Springs Flat, Fish Springs National Wildlife Refuge contains three major and many minor springs. These springs have a combined flow of 45 cfs to 50 cfs (Bolen, 1964), and has an inundated area of 6 mi by 3 mi.

The term "floodplain" refers to any land area susceptible to being inundated from any source of flooding. Executive Order 11988 directs implementation of the "United National Program for Flood Plain Management" (U.S. Water Resources Council, 1976) which recommends federal and state action to reduce the risk of flood losses through floodplain management. The base floodplain is the area subject to inundation from a flood having a one percent chance of occurring in any given year (100-year flood).

The Nevada/Utah study area presents problems in dealing with the traditional definitions and applications for floodplains. Defining a static floodplain for a certain magnitude flood is difficult, due to the nature of desert floods. Flood waters in the study area form a sheetlike action upon contact with the alluvium where the depth is very shallow (a few inches to several feet) and is spread out, covering a relatively large surface area. Since floods carry and deposit substantial amounts of debris, a subsequent occurrence will be redirected by that debris and result in a different area of inundation. Depending on soil moisture conditions and the magnitude of the flood, at some point flood waters become subsurface flow. This subsurface flow can effectively become a subsurface flood (Doug James, Utah State WRL 1980). Therefore, depending on the conditions, a floodplain might be subsurface.

Three types of floods occur in the Great Basin area: snowmelt, rain on snow and thunderstorms. Snowmelt floods occur from April through June, rain on snow generally happens November through March, and thunderstorms occur principally during the summer and fall months. Generally, the maximum annual and most frequent type of flood in the project study area is caused by thunderstorm activity.

Although thunderstorms may occur on many days in one season and be spread over a large area, the high intensity rainfall is limited to small areas. Indications are that as much as 7 in. of rain may fall in less than one hour. It is this high intensity, usually occurring in less than 1 square mi, which produces floods and sometimes mud-rock flows. Mud-rock flows have been described as mud, rock, debris, and water mixed to a consistency of wet concrete and usually traveling at a low velocity. Flood measurements, however, have shown that flood peaks may exceed 3,000 cfs per square mi from some small drainage basins.

Principal physiographic factors affecting flood flows are: drainage area, altitude, geology, basin shape, slope, aspect and vegetal cover. Graphs showing the magnitude and frequency of floods for recurrence intervals, ranging between 1.1 and 50 years have been published by the U.S. Geological Survey (Butler, Reid and Berwick, 1966).

Air Quality (3.2.2.3)

The federal, Nevada, and Utah ambient air quality standards are presented in Table 3.2.2.3-1. Sulfur dioxide standards have been violated in the Steptoe Valley, mainly due to the copper smelter at McGill (Figure 3.2.2.3-1). Ambient monitoring data in other portions of the study area are not sufficient to determine whether any other standards have been violated.

Only one Mandatory Class I Air Quality Area (no degradation permitted), Jarbidge National Wilderness Area, has been identified in Nevada and one area, Death Valley, has been recommended for redesignation to Class I status. In Utah, there are three Class I areas: Capitol Reef, Zion, and Bryce Canyon National Parks. There is one area recommended for consideration for redesignation to Class I status, the Cedar Breaks National Monument in Utah (Figure 3.2.2.3-1). Great Basin National Park is proposed. The primary location is the Spring Valley/Baking Powder Flat area of eastern Nevada, and three alternative sites in central Nevada near Big Sand Springs, Hot Creek, and Stone Cabin valleys. Formal designation by congressional action will create a Mandatory Class I Air Quality Area.

Mining and Geology (3.2.2.4)

The Nevada/Utah area is made up of mountain ranges of Paleozoic sedimentary, or Cenozoic volcanic bedrock separated by alluvium-filled valleys. The ranges and valley are separated by steeply dipping faults, many of which show evidence of recent (less than one million years) activity. The uplifted mountain ranges are the sites of mineralization. The down-dropped valleys contain alluvial fill to thicknesses up to 10,000 ft.

Seismicity (3.2.2.4.1)

Faults, mostly active during late Tertiary and Quaternary periods, parallel most of the north-south mountain ranges. There is some Holocene volcanic activity in the region. The western Nevada region (Ventura-Winnemucca zone) and the central Utah region (Intermountain Seismic Belt) are the areas of highest seismic risk. An earthquake registering 7.3 on the Richter scale occurred in western Nevada in 1954.

Minerals (3.2.2.4.2)

Known mineral deposits are found primarily in the mountain ranges (Figure 3.2.2.4-1). It is highly likely that mineralization also occurs under the valley alluvium. With present technology, it would be possible to find and develop only those deposits under shallow alluvial cover along the edges of the valleys. The most likely occurrences are extensions of known deposits that have been down-dropped by faulting.

Conditions are suitable to the formation of zeolite deposits. Studies have disclosed a possibility of correlating the few asbestiform varieties of this large mineral group, such as erionite and mordinite, with an incidence of lung cancer. In Nevada, there are 18 known and possibly commercial zeolite deposits distributed over nine counties: Churchill, Elko, Esmeralda, Eureka, Lander, Lincoln, Lyon, Nye, and Pershing. Only one of these deposits, Jersey Valley erionite in the northern end

Table 3.2.2.3-1. Summary of National Ambient Air Quality Standards (NAAQS) and Nevada and Utah* ambient air quality standards.

POLLUTANT	AVERAGING TIME	NAAQS AND UTAH STANDARDS		NEVADA STANDARDS
		PRIMARY	SECONDARY	PRIMARY
Carbon Monoxide	8-hour[a]	10 mg/m^3 (9 ppm)	Same as primary standards	Same as NAAQS
	1-hour[a]	40 mg/m^3 (35 ppm)		Same as NAAQS
Carbon Monoxide above 5,000 feet MSL	8-hour[a]	10 mg/m^3 (9 ppm)		6.67 mg/m^3 (6.0 ppm)
	1-hour[a]	40 mg/m^3 (35 ppm)		Same as NAAQS
Ozone	1-hour[b]	235 µg/m^3 (0.12 ppm)	Same as primary standards	Same as NAAQS
Ozone (Lake Tahoe Basin)	1-hour[b]	Not applicable	Not applicable	195 µg/m^3 (0.10 ppm)
Nitrogen Oxide	Annual (Arithmetic Mean)	100 µg/m^3 (0.05 ppm)	Same as primary standard	Same as NAAQS
Hydrocarbons (corrected for methane)	3-hour (6-9 a.m.)	160 µg/m^3 (0.24 ppm)	Same as primary standard	Same as NAAQS
Sulfur Dioxide	Annual (Arithmetic Mean)	80 µg/m^3 (0.03 ppm)	Same as primary standard	Same as NAAQS
	24-hour[a]	365 µg/m^3 (0.14 ppm)		Same as NAAQS
	3-hour[a]	None	1,300 µg/m^3 (0.5 ppm)	1,300 µg/m^3 (0.5 ppm)
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 µg/m^3	60 µg/m^3 [c]	75 µg/m^3
	24-hour[a]	260 µg/m^3	150 µg/m^3	150 µg/m^3
Lead	Quarterly (Arithmetic Mean)	1.5 µg/m^3	Same as primary standard	Same as NAAQS

2809-1

*All Utah standards are equivalent to NAAQS.

[a]Not to be exceeded more than once per year.

[b]The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

[c]Secondary annual TSP standard (60 µg/m^3) is a guide for assessing State Implementation Plans.

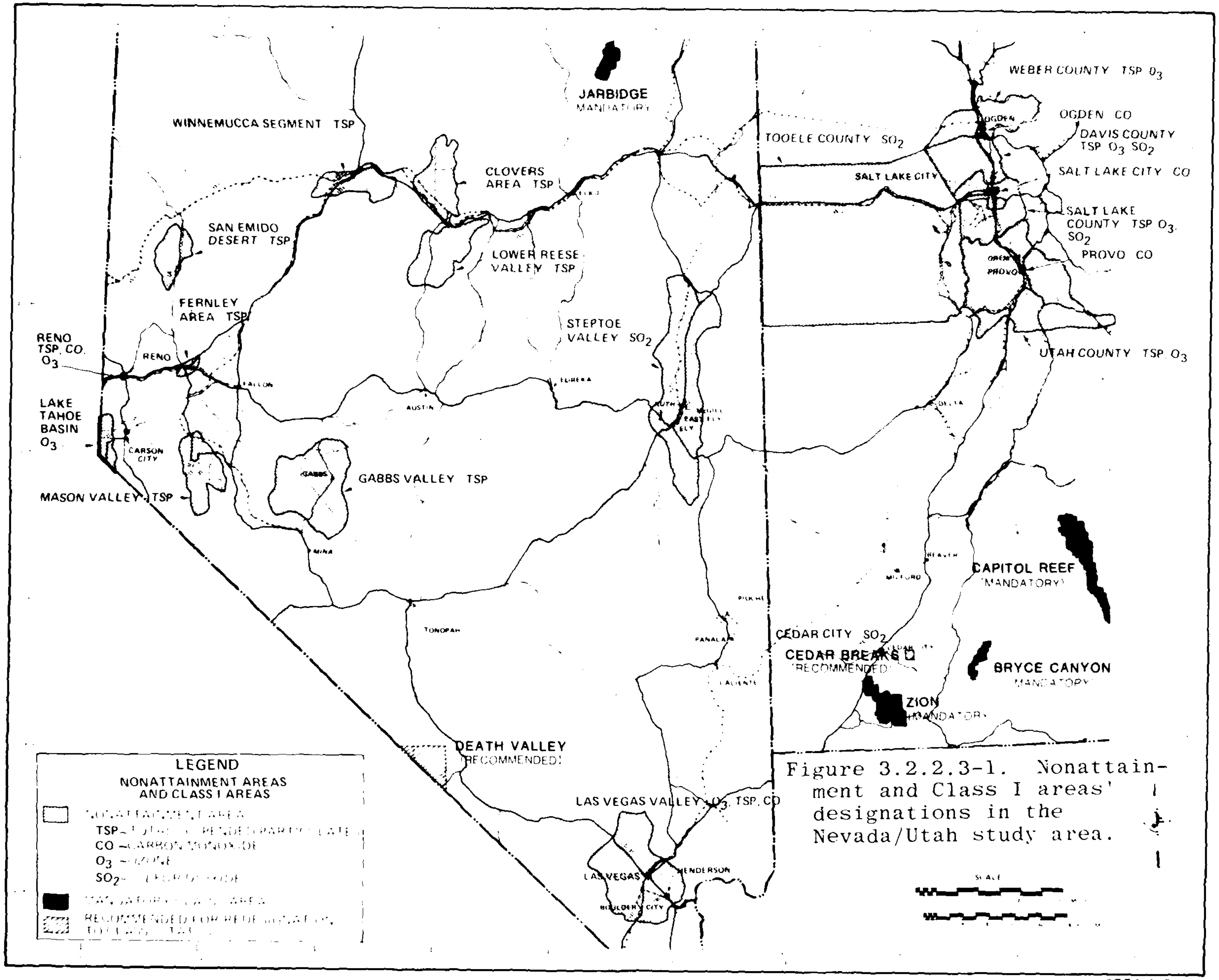

Figure 3.2.2.3-1. Nonattainment and Class I areas' designations in the Nevada/Utah study area.

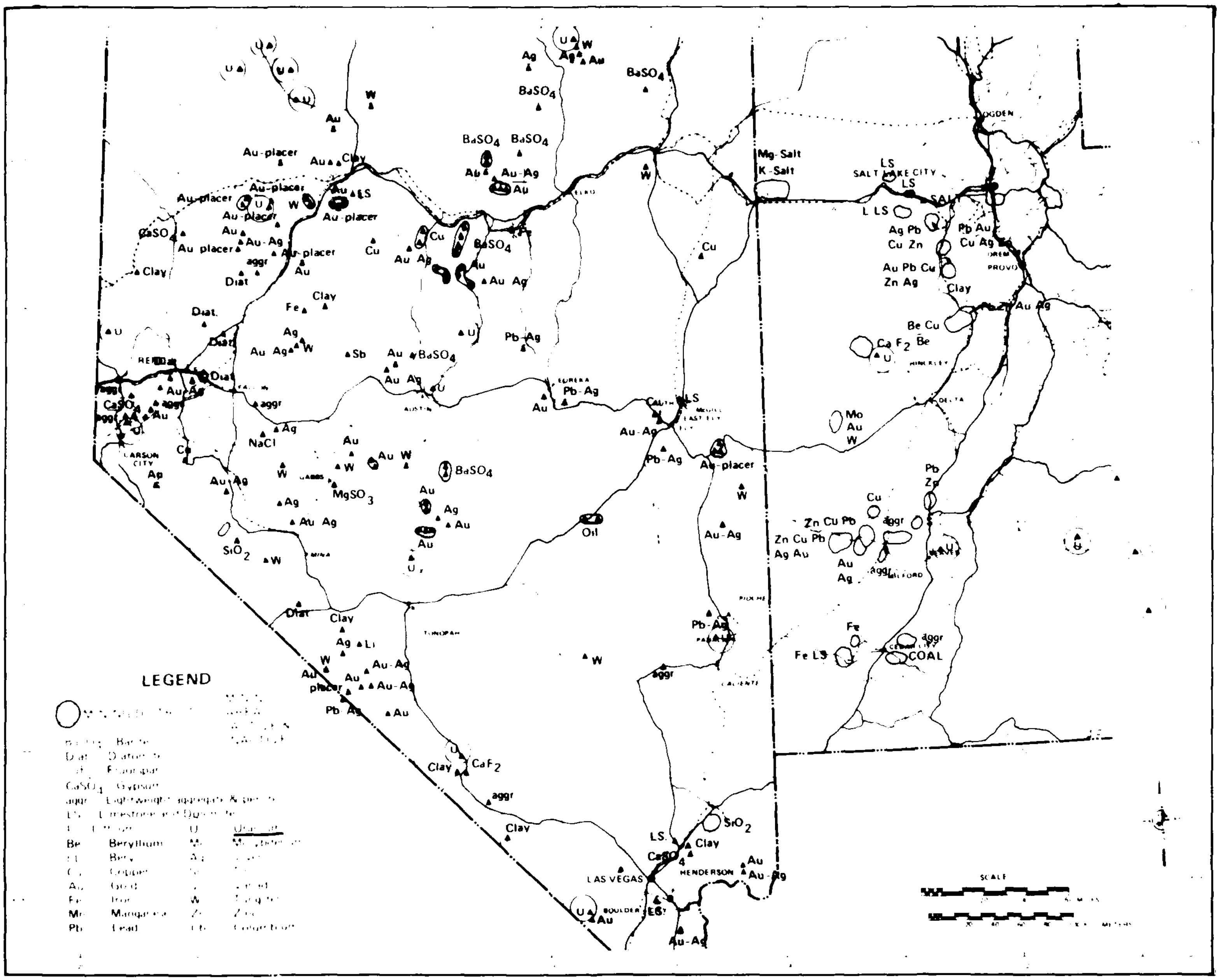

Figure 3.2.2.4-1. Occurrence of mineral deposits within and near the Nevada/Utah study site.

312-C-1

of Dixie Valley in Pershing County, has had significant past production. One potentially commercial deposit of zeolites has been reported in the Great Basin of Utah, near Cover Fort.

More than 200 economically valuable metallic elements and minerals are known to exist in Nevada. Nevada's mineral output, including petroleum, dropped to $291.1 million in 1978, a decrease of 26 percent from that of 1977. The decreased output was primarily due to three major copper mine shutdowns. Nevada's largest zinc producer also closed. Tables 3.2.2.4-1 and 3.2.2.4-2 show mineral statistics for study area counties. The study area counties produce over half of the state's mineral wealth.

In 1978, Utah's production of copper, gold, silver, lead and zinc was valued at $465 million, almost 30 percent of the value of the state's mineral production. Approximately 14 percent of the nation's new copper is produced in Utah. Utah also is an important producer of beryllium, gold, silver, lead, and molybdenum, zinc, and iron.

Utah's major nonmetallic mineral products are sand, gravel, salt, and gypsum (Tables 3.2.2.4-3 and 3.2.2.4-4). The state exports potash, salt, gypsum, and magnesium chloride. The study area counties, while producing a low percentage of the state's mineral wealth, have the only production of beryllium.

Vegetation and Soils (3.2.2.5)

A simplified vegetation type map for the Nevada/Utah area is shown in Figure 3.2.2.5-1. The valleys in the study area are dominated by Great Basin sagebrush, shadscale scrub, alkali sink scrub, and pinyon-juniper woodland (Figure 3.2.2.5-2). Mountain ranges separating the valleys are covered by pinyon-juniper woodland at lower elevations, with brushlands and sparse coniferous forests at higher elevations. The southern part of the study area is transitional between the Great Basin and hot desert floristic provinces and is dominated by creosote bush scrub with some Joshua tree woodland. Major vegetation types of the valleys and lower mountain slopes of the study area are summarized in Table 3.2.2.5-1.

The major disturbance to vegetation -- grazing by cattle, wild horses, and burros -- has changed plant species composition, with shrubs increasing over grasses. Areas of crested wheat-grass have been planted to improve grazing range in the northern and central portions. After disturbance, vegetation recovery rate is very slow, taking from decades to centuries.

The Nevada/Utah study area is made up of a series of valleys typically consisting of the following physiographic features and their characteristic soil types: (1) playas, (2) valley bottoms and floodplains, (3) alluvial fans and stream and lake terraces, and (4) uplands and mountains (Figure 3.2.2.5-3).

1. The playas consist of light-colored clayey deposits with very strong accumulations of salt. Any free water from melting snow and summer thunderstorms usually ponds on the surface with salt crusting sometimes occuring during dry periods. Playas are mostly devoid of vegetation, and severe wind erosion exists on disturbed surfaces.

Table 3.2.2.4-1. Minerals produced in Nevada study area counties.

COUNTY	MINERALS PRODUCED IN 1976, IN ORDER OF VALUE
Elko	Sand and gravel, barite, tungsten
Eureka	Gold, iron ore, stone, mercury
Lander	Copper, gold, barite, silver, lead, zinc
Lincoln	Stone, sand and gravel, perlite, zinc
Nye	Magnesite, petroleum, fluorspar, sand and gravel
White Pine	Copper, gold, lime, silver

[illegible]

Source: Bureau of Mines, Minerals Yearbook, 1976, (reprint), p. 3.

Table 3.2.2.4-2. Gross yield of mines in Nevada study area counties (1977).

COUNTY	$000[1]	PERCENT OF TOTAL (STATE)
Elko	11,033	5.8
Eureka	29,681	15.5
Lander	27,728	14.5
Lincoln	5,350	2.8
Nye	21,595	11.3
White Pine	26,536	13.8
Study Area Total	121,923	63.6

068-1

[1] State total is 191,6[illegible]5.

Source: University of Nevada, Bureau of Business [illegible] Economic Research, *Nevada Review of Business and Economics* (Summer, 1978), [illegible] adapted.

Table 3.2.2.4-3. Minerals produced in Utah study area counties (1975).

COUNTY	MINERALS PRODUCED, IN ORDER OF VALUE
Beaver	Sand and gravel
Iron	Iron ore, sand and gravel
Juab	Fluorspar, clays, gypsum, sand and gravel
Millard	Gypsum, stone, pumice, beryllium, sand and gravel
Tooele	Potassium salts, salt, lime, stone, sand and gravel

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Source: U.S. Bureau of Mines, *Minerals Yearbook 1975: Volume II Area Reports, Domestic* (1978), p. 749.

Table 3.2.2.4-4. Value of mineral production in Utah study area counties (1975).

COUNTY	VALUE	
	$000	PERCENTAGE OF STATE
Beaver	176	negligible
Iron (1974)	14,727	1.5
Juab	627	negligible
Millard	*	negligible
Tooele	12,110	1.3
Study Area Total	27,640+	2.9
Utah Total	966,407	100.0

093

*Withheld to avoid disclosing individual company confidential data.

Source: U.S. Bureau of Mines, *Minerals Yearbook 1975: Volume II Area Reports, Domestic*, p. 749.

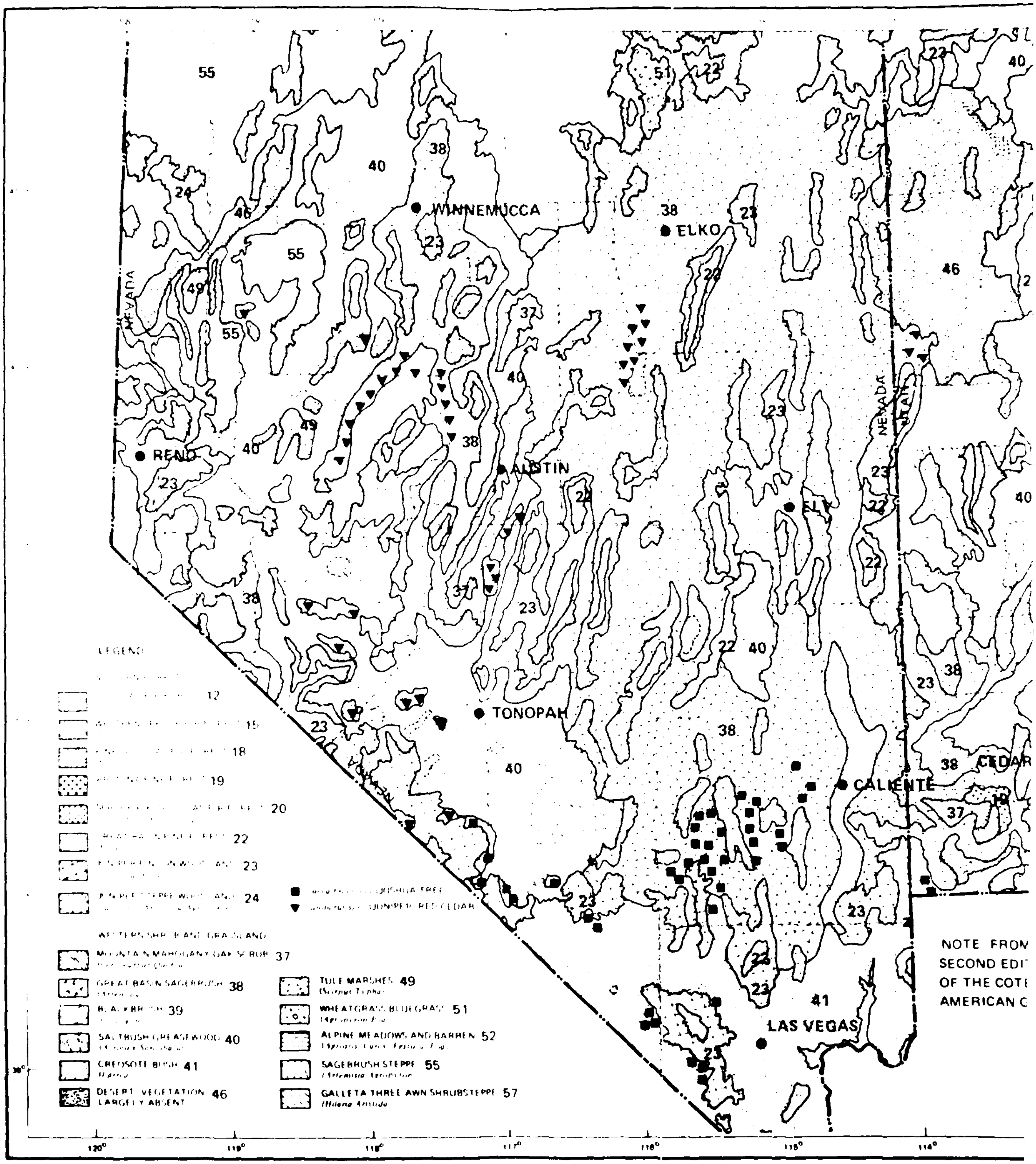


Figure 3.2.2.5-1. Simplif

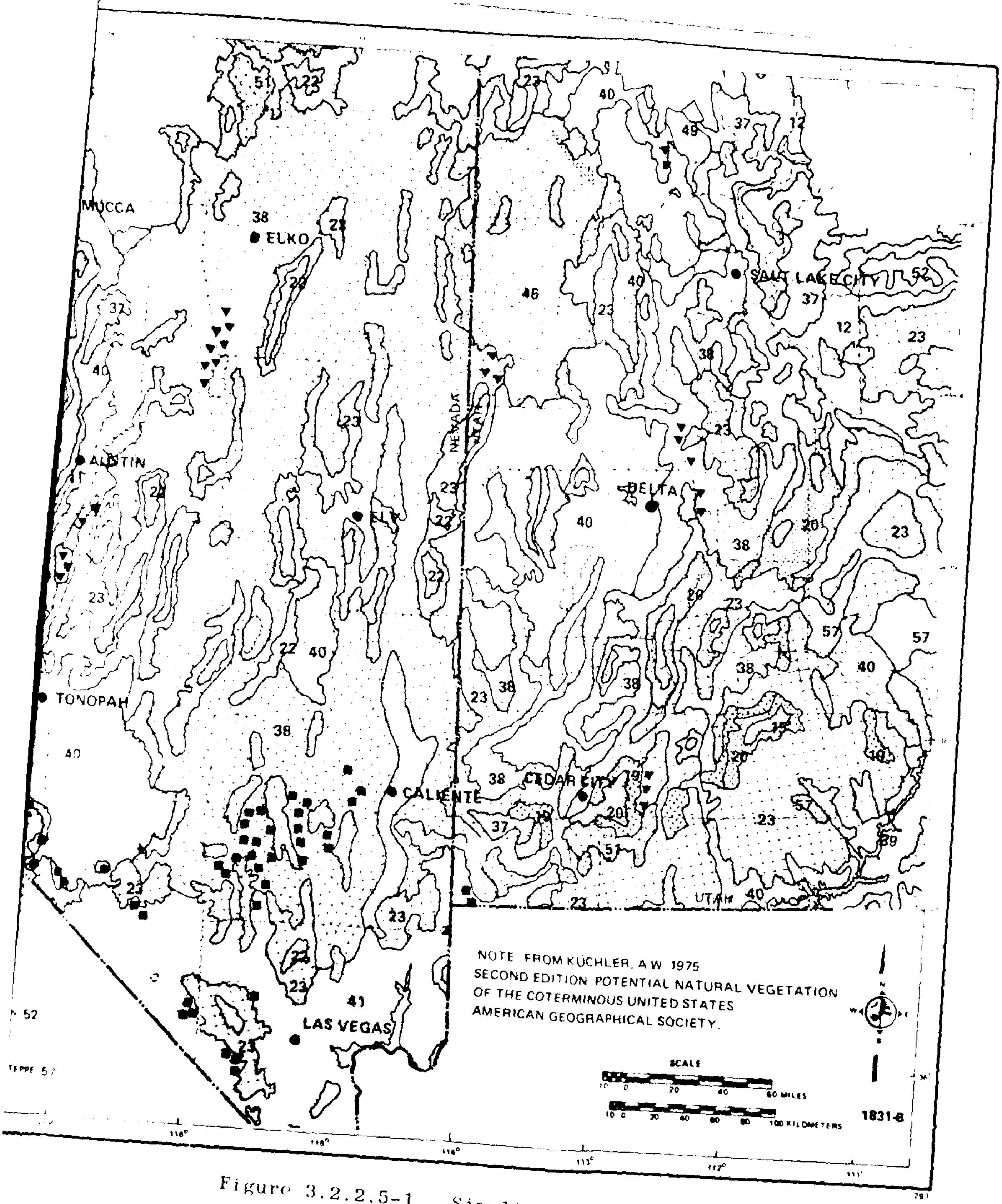


Figure 3.2.2.5-1. Simplified vegetation type map for Nevada/Utah.

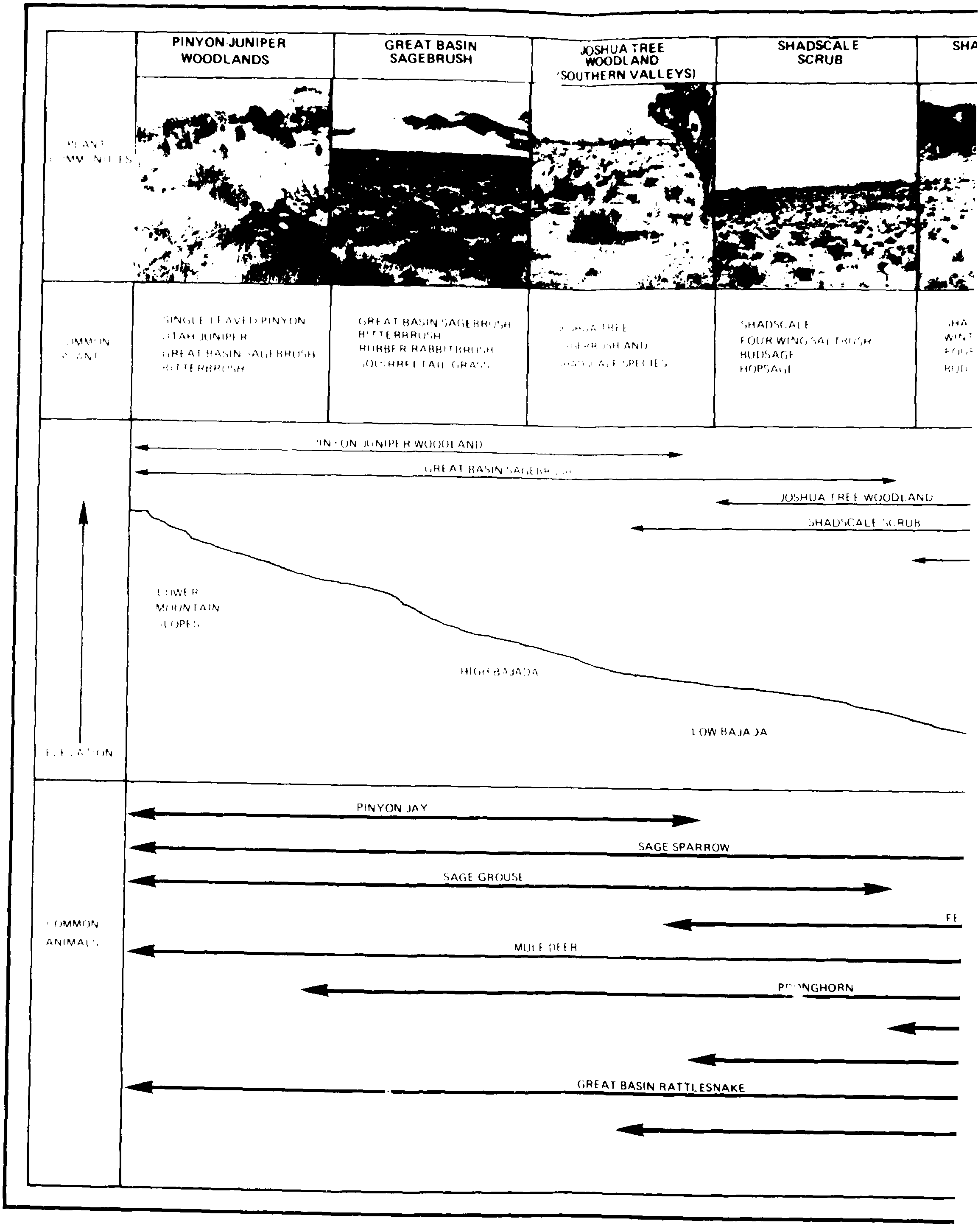
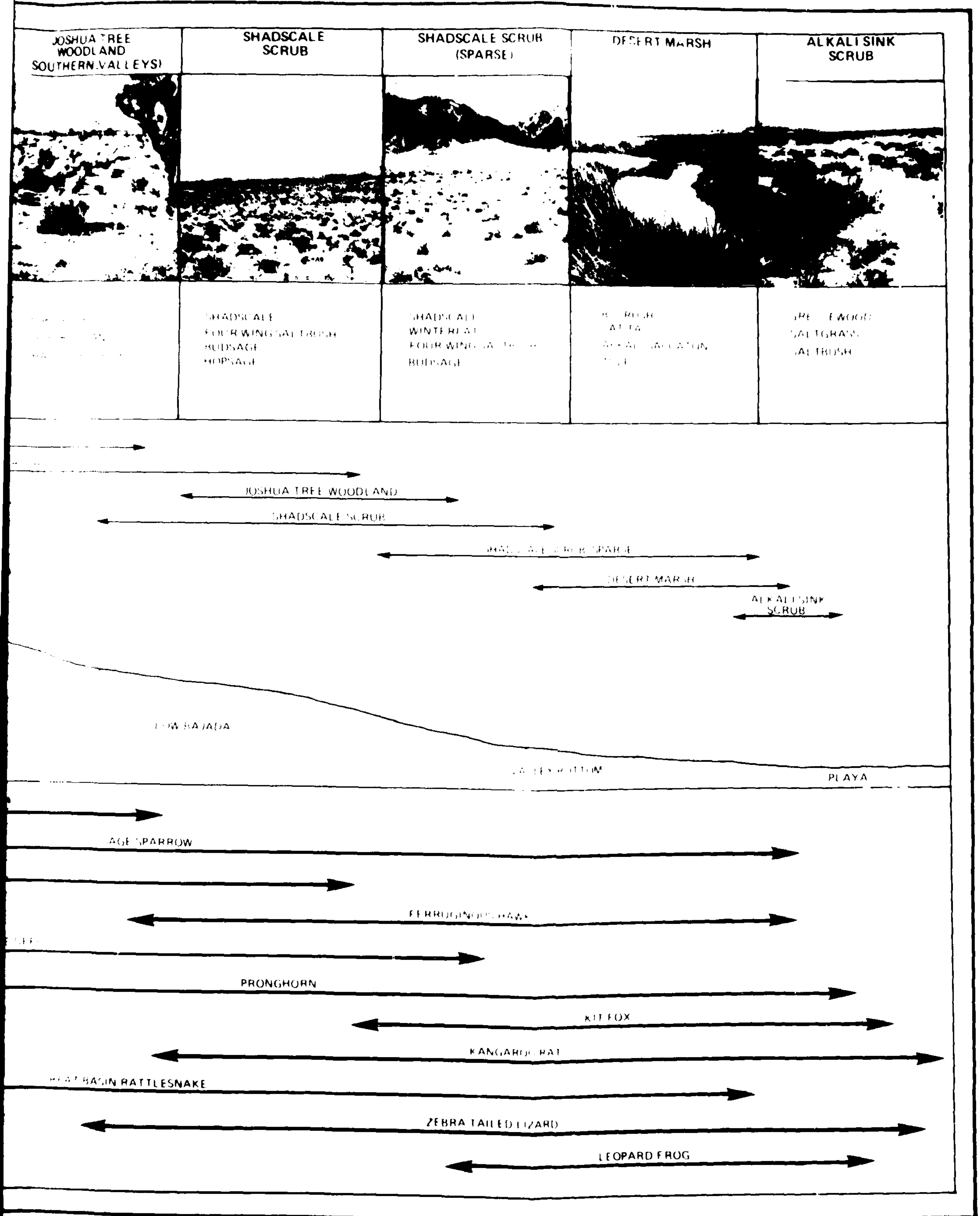


Figure 3.2.2.5-2. Plant and animal relationships along an elevational



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relationships along an elevational gradient in the Nevada/Utah study area.

Table 3.2.2.5-1. Major vegetation types in the Nevada/Utah study area.

TYPE	GENERAL LOCATION	COMPOSITION	SOURCES OF PRESENT DISTURBANCE
Alkali [illegible]	Low elevations, valley bottoms, playa margins; in saline or alkaline clay soils; Nevada and Utah	Shrubs one meter tall or less and low herbs	Grazing; off-road vehicles
[illegible]	Dry areas of low topographic relief; southern Nevada and southwestern Utah	Shrubs dominate, with perennials herbs, grasses, and annuals	Off-road vehicles
[illegible] Vegetation	Low elevations, dry stream courses and major drainage channels; southern Nevada	Medium-sized to large shrubs, perennial and annual herbs and grasses	Flash floods, cattle grazing
Desert Marsh and Spring Vegetation	Low elevations where the water table lies near the ground surface; scattered throughout Nevada and Utah	Small trees, shrubs, perennial herbs and grasses; species vary according to salinity of soil and water	Damming and impounding of water for livestock, trampling by livestock, and pollution and sedimentation from recreation and other uses
[illegible] Streambank [illegible]	Along banks of perennial and some intermittant streams	Varying densities of mesophytic deciduous trees	Trampling by livestock, pollution and sedimentation from recreation and other uses
[illegible]	Valley bottoms or rocky slopes; Nevada and southwestern Utah	Low shrubs, perennial herbs and grasses	Grazing, erosion, off-road vehicles
[illegible]	Rocky mountainsides, broad valleys, and low foothills; in deep, permeable, non-saline soils; central and northern Nevada Utah	Dense shrubs and bunchgrasses	Overgrazing, discing, and defoliant spraying development of strip mining and urban areas, off-road vehicles, and other recreation uses
[illegible] Woodland	Mountainous terrain and high plateaus; central and northern Nevada, Utah	Small evergreen trees, large shrubs, perennial herbs and grasses	Overgrazing; vegetation removal from mining operations; airborne pollutants, off-road vehicles

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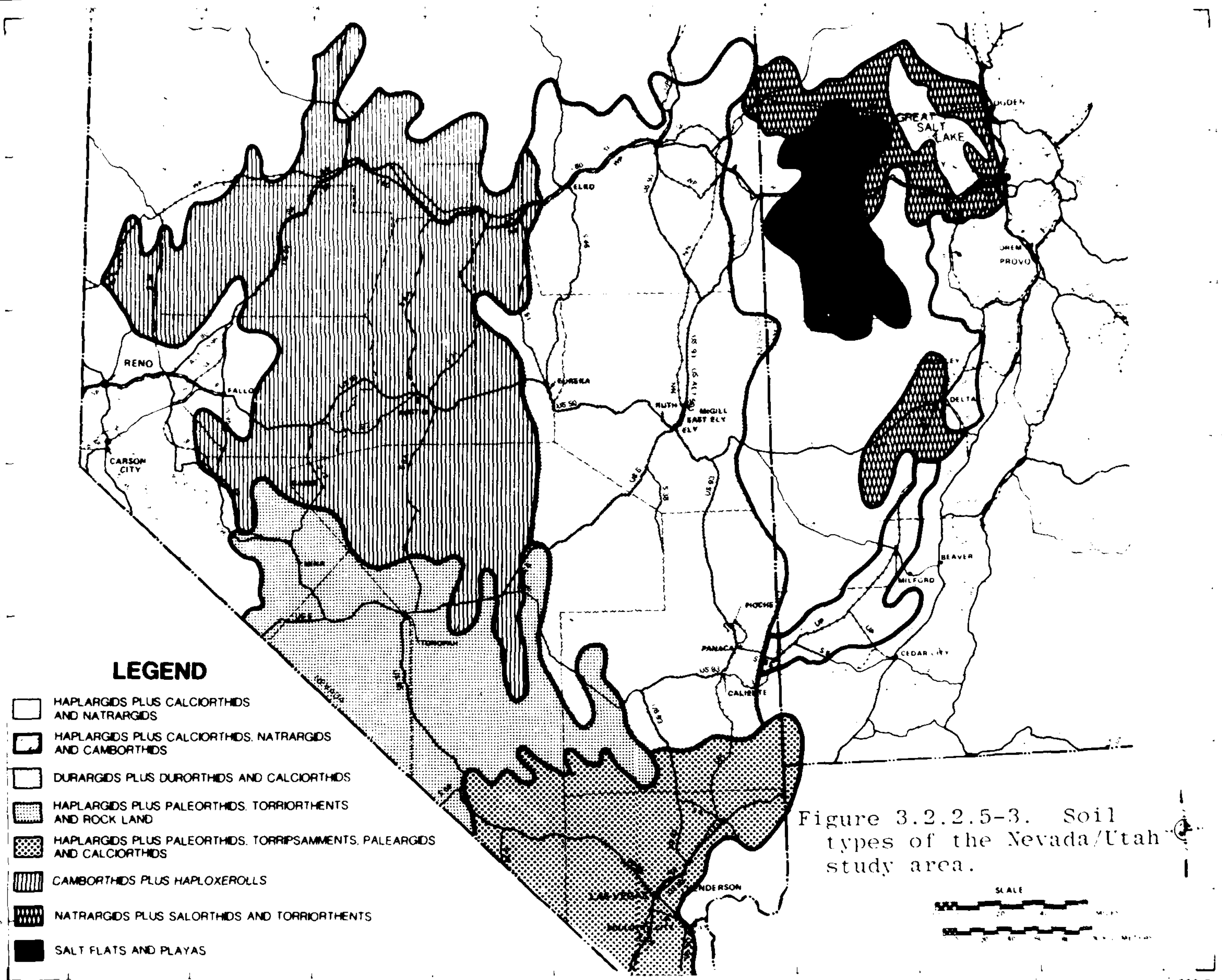

Figure 3.2.2.5-3. Soil types of the Nevada/Utah study area.

2. The valley bottoms and floodplains have smooth to gently undulating slopes with deep, alkaline soils. The surface textures range from loams to silty clay loams, while the subsoils range from fine loams to fine silts. Permeability ranges from very slow to moderately rapid and wind erosion of the disturbed soil is moderate.

3. The alluvial fans and streams and lake terraces make up the largest areas in the valleys. The soils vary in depth and are alkaline. The surface textures range from fine sands to gravelly sandy loams to silty clay loams, while the subsoils range from sands to loamy skeletal to fine loamy. Cemented hardpans are common at varying depths below the surface. In general, the gravel content of the deposits increases near the base of mountains. Permeability of these soils ranges from slow to rapid.

4. The uplands and mountains have shallow to deep, moderately alkaline to medium acid soils. Surface textures range from cobbly to sandy to gravelly loams, while the subsoils range from loamy skeletal to clayey skeletal. These soils are often underlain by bedrock.

A surface pavement of rock fragments is present over many of the soils. Much of this desert pavement has been produced by winds removing the finer soil particles from the surface.

Wildlife (3.2.2.6)

Common and Typical Species (3.2.2.6.1)

Common and typical terrestrial animals of the study area are listed in Table 3.2.2.6-1. Wild horses, protected by the Wild Free-Roaming Horse and Burro Act of 1971, occur in many valleys and compete for forage with domestic livestock and native species (Figure 3.2.2.6-1). Nocturnal rodents account for most of the small mammals. Reptile diversity is low as a result of relatively low mean annual temperatures and generally less suitable habitat in valleys. Low amphibian diversity results from general aridity, lack of summer rains, and isolation from colonizing sources; only a few species have been introduced or have survived in isolated springs and small streams since the last glacial period. The areas with the highest bird diversity in the study area are the mountain and riparian habitat types (Table 3.2.2.6-2).

Game Animals (3.2.2.6.2)

Big game species in the study area include mule deer, pronghorn antelope, bighorn sheep, and elk (Figures 3.2.2.6-2, 3.2.2.6-3, 3.2.2.6-4, and 3.2.2.6-5). Wide ranges of habitats are found, including basins, high mountain ranges, forests, woodlands, and scrublands.

Wetlands in valleys are important stopover areas or breeding habitat foı large numbers of migratory waterfowl, including ducks, geese, and swans (Figure 3.2.2.6-6).

Table 3.2.2.6-1. Common and typical amphibians, reptiles, and mammals, Nevada/Utah study area (Pg. 1 of 2).

SPECIES	AQUATIC	RIPARIAN	BIG SAGE	SHADSCALE-GREASEWOOD	SAND DUNE-SANDY	PINYON-JUNIPER WOODLAND
Amphibians						
FROGS AND TOADS						
Great Basin Spadefoot *Scaphiopus intermontanus*	x	x	x			x
Reptiles						
LIZARDS						
Zebra-tailed Lizard *Callisaurus draconoides*				x	x	
Leopard Lizard *Gambelia wislizenii*			x	x	x	
Collared Lizard *Crotaphytus collaris*				x		
Side-blotched Lizard *Uta stansburiana*			x	x	x	x
Desert Horned Lizard *Phrynosoma platyrhinos*				x	x	
Western Whiptail *Cnemidophorus tigris*			x	x	x	x
Western Fence Lizard *Sceloporus occidentalis*		x	x			
Desert Spiny Lizard *S. magister*		x		x		
Sagebrush Lizard *S. graciosus*			x	x		
Western Skink *Eumeces skiltonianus*		x				
SNAKES						
Common Kingsnake *Lampropeltis getulus*		x				x
Coachwhip *Masticophis flagellum*				x		
Striped Whipsnake *M. taeniatus*			x	x		
Western Patch-nosed Snake *Salvadora hexalepis*				x		
Great Basin Gopher Snake *Pituophis melanoleucus*			x	x		x
Long-nose Snake *Rhinocheilus lecontei*				x	x	
Western Groundsnake *Sonora semiannulata*					x	
Spotted Nightsnake *Hypsiglena torquata*			x			
Great Basin Rattlesnake *Crotalus viridis lutosus*			x	x	x	x
Mammals						
INSECTIVORES						
Merriam Shrew *Sorex merriami*			x			
BATS						
Small-footed Myotis *Myotis subulatus*			x			x
California Myotis *M. californicus*				x		x
Little Brown Myotis *M. lucifugus*		x				x
Western Pipistrelle *Pipistrellus hesperus*				x		x
Big Brown Bat *Eptesicus fuscus*		x	x	x		x
Pallid Bat *Antrozous pallidus*			x	x		
Big-eared Bat *Plecotus townsendi*			x			x
Big Freetail Bat *Tadarida macrotis*						x

Table 3.2.2.6-1. Common and typical amphibians, reptiles, and mammals, Nevada/Utah study area (Pg. 2 of 2).

SPECIES	AQUATIC	RIPARIAN	BIG SAGE	SHADSCALE-GREASEWOOD	SAND DUNE-SANDY	PINYON-JUNIPER WOODLAND
Mammals (Continued)						
RODENTS						
Rock Squirrel *Spermophilus variegatus*			x	x		x
Whitetail Antelope Ground Squirrel *Ammospermophilus leucurus*				x	x	x
Valley Pocket Gopher *Thomomys bottae*			x	x		x
Little Pocket Mouse *Perognathus longimembris*			x	x	x	x
Great Basin Pocket Mouse *P. parvus*			x	x		x
Ord's Kangaroo Rat *Dipodomys ordii*			x	x	x	
Great Basin Kangaroo Rat *D. microps*			x	x	x	
Western Harvest Mouse *Reithrodontomys megalotis*		x	x	x		
Deer Mouse *Peromyscus maniculatus*		x	x	x		x
Canyon Mouse *P. crinitus*				x		
Southern Grasshopper Mouse *Onychomys torridus*			x	x		
Sagebrush Vole *Lagurus curtatus*			x			
Mountain Vole *Microtus montanus*	x					
Desert Woodrat *Neotoma lepida*				x		
Porcupine *Erethizon dorsatum*		x	x			x
RABBITS						
Black-tailed Jackrabbit *Lepus californicus*			x	x		x
Desert Cottontail *Sylvilagus audubonii*		x	x	x	x	x
CARNIVORES						
Badger *Taxidea taxus*			x	x		
Spotted Skunk *Spilogale gracilis*		x				x
Striped Skunk *Mephitis mephitis*		x	x	x		x
Coyote *Canis latrans*			x	x	x	x
Gray Fox *Urocyon cinereoargenteus*			x			x
Kit Fox *Vulpes macrotis*			x	x	x	x
Bobcat *Lynx rufus*		x	x	x		x
Mountain Lion *Felis concolor*						x

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Sources: Stebbins, 1966; Burt and Grossenheider, 1976; Hall [illegible]

Important upland game include a variety of grouse species, mourning dove, pheasant, wild turkey, pigeon, quail, partridge, and cottontail rabbits. The distributions of sage grouse, blue grouse, quail, and chukar partridge are shown in Figures 3.2.2.6-7, 3.2.2.6-8, and 3.2.2.6-9.

Major furbearers are mink, raccoon, badger, skunk, weasel, bobcat, coyote, fox, beaver, and muskrat.

Aquatic Species (3.2.2.7)

Aquatic Habitat (3.2.2.7.1)

The intermittent nature and salinity/alkalinity of most streams and playas limits the development of aquatic life. Playas may support short-lived populations of brine shrimp, algae, and zooplankton. Birds may feed on these when abundant. The perennial habitats include small springs, streams, and a few reservoirs and ponds (Figure 3.2.2.7-1). Some isolated spring habitats are, however, subject to drying due to nearby water table lowering.

Aquatic Biota (3.2.2.7.2)

Mountain streams and cold water springs provide habitat for fish, particularly trout (Table 3.2.2.7-1). Reservoirs and ponds are usually stocked with trout and pike and warm-water fish such as bass, sunfish, and catfish. A great variety of endemic fish (many of which are protected) inhabit isolated springs and streams that were left when Pleistocene lakes dried up.

Protected Species (3.2.2.8)

For purposes of this discussion, the term "protected species" applies to rare, threatened, or endangered species that are candidates for or already included on state or federal lists.

Plant Species (3.2.2.8.1)

Numerous species of rare plants are being considered for protection under federal and state endangered species legislation in Nevada and western Utah. Several species in Utah have already been federally listed for protection under the Endangered Species Act of 1973. Three of these endangered species, the purple-spined hedgehog cactus (*Echinocereus engelmanii* var. *purpureus*), the Siler pincushion cactus (*Pediocactus sileri*), and the dwarf bear poppy (*Arctomecon humilis*), occur in southwestern Utah near the study area. None has yet been federally listed in Nevada. Nine rare plant species have been listed by the U.S. Fish and Wildlife Service as species for which the Service is preparing a rulemaking package; these species have a high probability of being listed for protection (USFWS, 1980). Eighteen rare plant species in Nevada have been listed for protection by the Nevada Forestry Division under NRS 527.270, and all of these are likely to be directly or indirectly affected by the project. In addition, all species of the family Cactaceae, the genus *Yucca*, and all evergreen trees are protected under NRS 527.050 and NRS 527.070. Utah has no state laws which afford protection to rare plants.

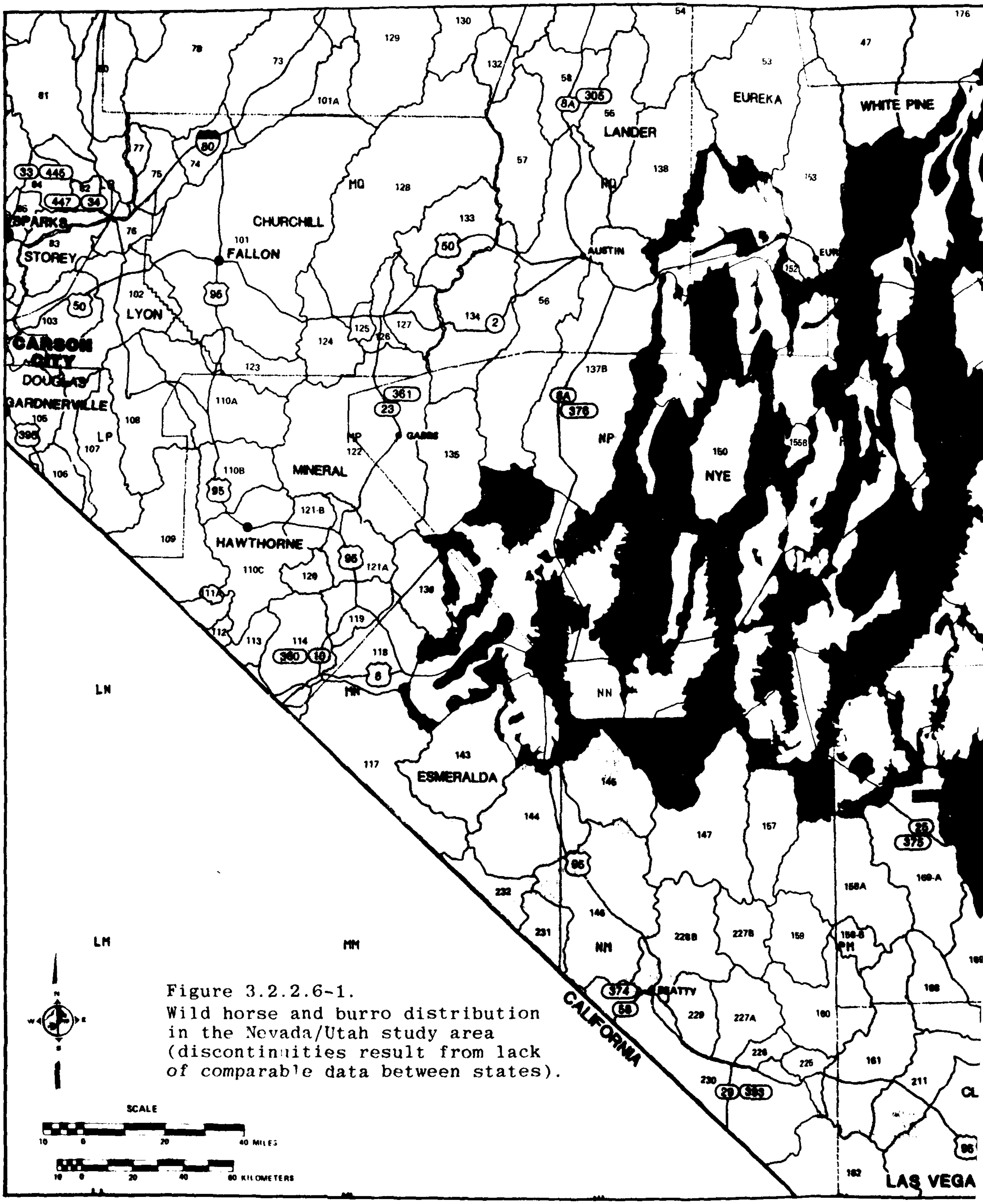
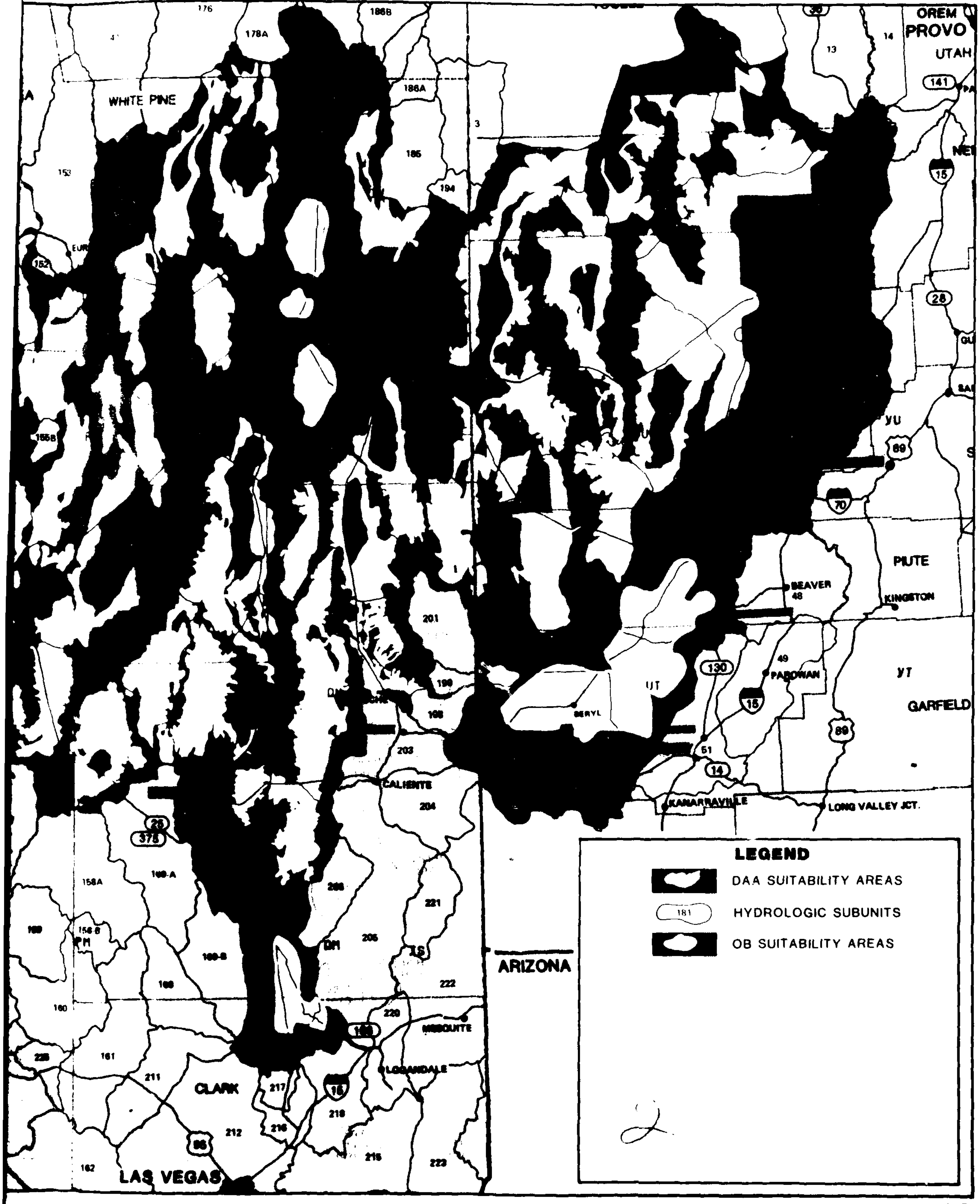


Figure 3.2.2.6-1.
Wild horse and burro distribution in the Nevada/Utah study area (discontinuities result from lack of comparable data between states).



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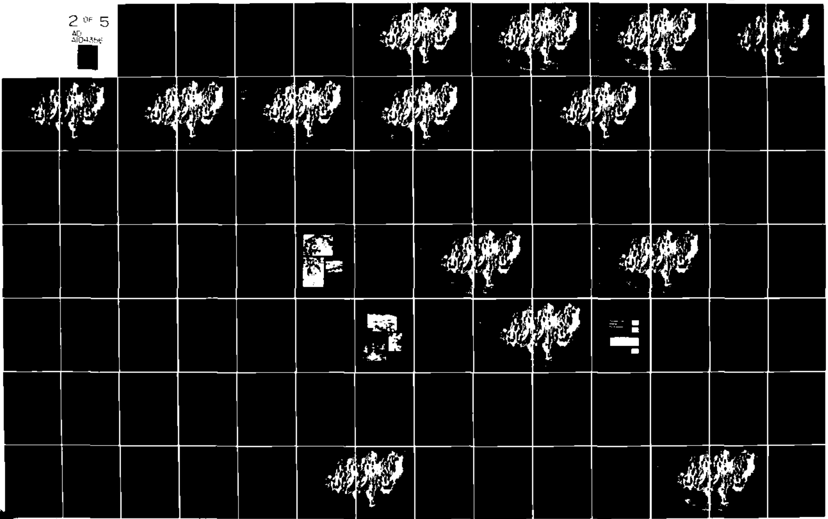

Table 3.2.2.6-2. Common and typical species of birds of the Nevada/Utah study area (Pg. 1 of 3).

SPECIES	AQUATIC	RIPARIAN	BIG SAGE	SHADSCALE AND GREASEWOOD	PINYON-JUNIPER WOODLAND	TREE PLANTATIONS
Raptors (Falconiformes)						
Turkey Vulture *Cathartes aura*			[illegible]	S		[illegible]
Cooper's Hawk *Accipiter cooperii*						P
Red-tailed Hawk *Buteo jamaicensis*		[illegible]	[illegible]		P	P
Rough-legged Hawk *Buteo lagopus*				W		
Ferruginous Hawk *Buteo regalis*				ST		
Golden Eagle *Aquila chrysaetos*	P	P	P	P	P	P
Marsh Hawk *Circus cyaneus*	P	P	P	P	[illegible]	P
Prairie Falcon *Falco mexicanus*		P	P	P		P
Kestrel *Falco sparverius*		P	P	P	[illegible]	P
Doves (Columbidae)						
Mourning Dove *Zenaida macroura*	ST	ST	ST		ST	ST
Owls (Strigidae)						
Great Horned Owl *Bubo virginianus*		P				P
Burrowing Owl *Athene cunicularia*				P		
Nightjars (Caprimulgidae)						
Poorwill *Phalaenoptilus nuttallii*		[illegible]		S		
Common Nighthawk *Chordeiles minor*	ST	ST	ST		ST	
Woodpeckers (Picidae)						
Flicker *Colaptes auratus*		P	P		P	P
Downy Woodpecker *Dendrocopos pubescens*		P				P
Red-naped Sapsucker *Sphyrapicus varius*		W				W
Flycatchers (Tyrannidae)						
Western Kingbird *Tyrannus verticalis*		ST		ST	ST	ST
Say's Phoebe *Sayornis saya*		S			S	S
Dusky Flycatcher *Empidonax oberholseri*		T				T
Gray Flycatcher *Empidonax wrightii*			ST			
Western Wood Pewee *Contopus sordidulus*		T				T
Larks (Alaudidae)						
Horned Lark *Eremophila alpestris*				P		
Swallows (Hirundinidae)						
Violet-green Swallow *Tachycineta thalassina*	ST	ST	ST	ST	ST	ST
Tree Swallow *Iridoprocne bicolor*	ST	ST	ST	ST	ST	ST
Barn Swallow *Hirundo rustica*	ST	ST	ST	ST	ST	ST
Cliff Swallow *Petrochelidon pyrrhonota*	ST	ST	ST	ST	ST	ST

Table 3.2.2.6-2. Common and typical species of birds of the Nevada/Utah study area (Pg. 2 of 3).

SPECIES	AQUATIC	RIPARIAN	BIG SAGE	SHADSCALE AND GREASEWOOD	PINYON-JUNIPER WOODLAND	TREE PLANTATION
Crows (Corvidae)						
Raven *Corvus corax*		P	P	P	P	P
Scrub Jay *Aphelocoma coerulescens*					P	
Pinyon Jay *Gymnorhinus cyanocephalus*					P	
Black-billed Magpie *Pica Pica*		P	P		P	P
Bushtits (Paridae)						
Plain titmouse *Parus inornatus*					P	
Mountain Chickadee *Parus gambeli*		W				W
Wrens (Troglodytidae)						
Rock Wren *Salpinctes obsoletus*				P		
Thrashers (Mimidae)						
Sage Thrasher *Oreoscoptes montanus*			S		S	
Thrushes (Turdidae)						
Swainson's Thrush *Catharus ustulatus*		T				T
Hermit Thrush *Catharus guttatus*		T				T
Robin *Turdus migratorius*		T				TW
Kinglets (Polioptilidae)						
Blue-Gray Gnatcatcher *Polioptila caerulea*			S			
Ruby-crowned Kinglet *Regulus calendula*		T				T
Shrikes (Laniidae)						
Loggerhead Shrike *Lanius ludovicianus*				P		
Northern Shrike *Lanius excubitor*			W	W		W
Vireos (Vireonidae)						
Warbling Vireo *Vireo gilvus*		T				T
Solitary Vireo *Vireo solitarius*		T			S	
Warblers (Parulidae)						
Orange-crowned Warbler *Vermivora celata*		T				T
Yellow Warbler *Dendroica petechia*		ST				T
Yellow-rumped Warbler *Dendroica coronata*		T				T
House Sparrows (Ploceidae)						
House Sparrow *Passer domesticus*		P				P

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Table 3.2.2.6-2. Common and typical species of birds of the Nevada/Utah study area (Pg. 3 of 3).

SPECIES	AQUATIC	RIPARIAN	BIG SAGE	SHADSCALE AND GREASEWOOD	PINYON-JUNIPER WOODLAND	TREE PLANTATIONS
Blackbirds (Icteridae)						
Redwing *Agelaius phoeniceus*	ST	ST				T
Northern Oriole *Icterus galbula*		S	S			S
Brewer's Blackbird *Euphagus cyanocephalus*		ST	P			P
Brown-headed Cowbird *Molothrus ater*		ST				ST
Tanagers (Thraupidae)						
Western Tanager *Piranga ludoviciana*		T				T
Sparrows and Finches (Fringillidae)						
Black-headed Grosbeak *Pheucticus melanocephalus*		ST				T
House Finch *Carpodacus mexicanus*		P	P			P
American Goldfinch *Spinus tristis*		P				P
Green-tailed Towhee *Chlorura chlorura*			ST		ST	
Lark Sparrow *Chondestes grammacus*			S	S		
Black-throated Sparrow *Amphispiza bilineata*			S	S		
Sage Sparrow *Amphispiza belli*			S	S	S	
Dark-eyed (Oregon) Junco *Junco hyemalis*		TW	TW		TW	TW
Brewer's Sparrow *Spizella breweri*			ST		S	
White-crowned Sparrow *Zonotrichia leucophrys*		T	T	T	T	T
Song Sparrow *Melospiza melodia*	P	P				P

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P = Permanent resident

S = Summer only

T = Spring/Fall Transient

W = Winter Only

Under the Endangered Species Act of 1973, preliminary lists of endangered and threatened plant species were published in the Federal Register (FR:40:127:July 1, 1975, and FR:41:117:June 16, 1976). The 1975 list was a notice of review, and species included on it and not subsequently proposed or listed have been generally referred to as "candidate" threatened or endangered species. Species included on the 1976 list of 1,700 proposed endangered species have been generally referred to as "proposed" species. Both lists were screened to determine those species that are known to occur in or near the study areas in Nevada and Utah, and over 200 such species were identified.

Figure 3.2.2.8-1 shows locations of the rare plant species considered. Table 3.2.2.8-1 lists the species for Nevada and western Utah and gives a summary of the distribution and habitat information available. Table 3.2.2.8-2 gives substratum preferences for selected rare and endangered plant species in the study area. Recent changes in the Endangered Species Act (the amendments of 1978) have resulted in withdrawal of the 1976 proposals. Currently, rare plants are being reviewed on a case-by-case basis by federal and state authorities, and many species are likely to be elevated to formal protection under state or federal laws prior to commencement of M-X construction. A new notice of review is scheduled to be published in the Federal Register late this year (1980), which substantially reduces the number of species under considera tion.

There is a dearth of information on the ecological status and distributions of many rare plants in Nevada and Utah. Fairly complete literature and herbaria search data exist, and emphasis is now being placed on analysis of comprehensive field inventories that were undertaken by local experts during the growing season of 1980. These studies concentrated on 11 valleys within the project area. Should such studies continue, it is likely that some species of "rare" plants will be found to be common and abundant. For example, preliminary analysis shows that the bashful four o'clock (Mirabilis pudica) and the white-leaf machaeranthera (Machaeranthera leucanthemifolia) are abundant in Pahranagat Valley and should not be considered rare (Welsh and Neese, 1980). ETR-840, Field Programs, details methods and results. Rare plant lists for Nevada and Utah have recently been reviewed by local authorities (Northern Nevada Native Plant Society, 1980; Welsh and Thorne, 1979), and several species have either been added, delisted, or their status changed to more accurately reflect existing population trends.

Wildlife Species (3.2.2.8.2)

Several terrestrial species protected by the Endangered Species Act occur in the study area. The bald eagle winters throughout many of the valleys in the study area. The peregrine falcon migrates through the study area and many nest on the very eastern portion of the study area. The Utah prairie dog is a resident species occuring in southwestern Utah. State protected vertebrates found in or near the area include the desert tortoise (the population on the Beaver Dam Slope in southwestern Utah is federally listed as threatened) gila monster, and spotted bat (Figure 3.2.2.8-2).

Aquatic Species (3.2.2.8.3)

Many protected (8 federal and 23 state) and recommended protected (33) aquatic species are present (Figure 3.2.2.8-3, Table 3.2.2.8-3 and 3.2.2.8-4). Most

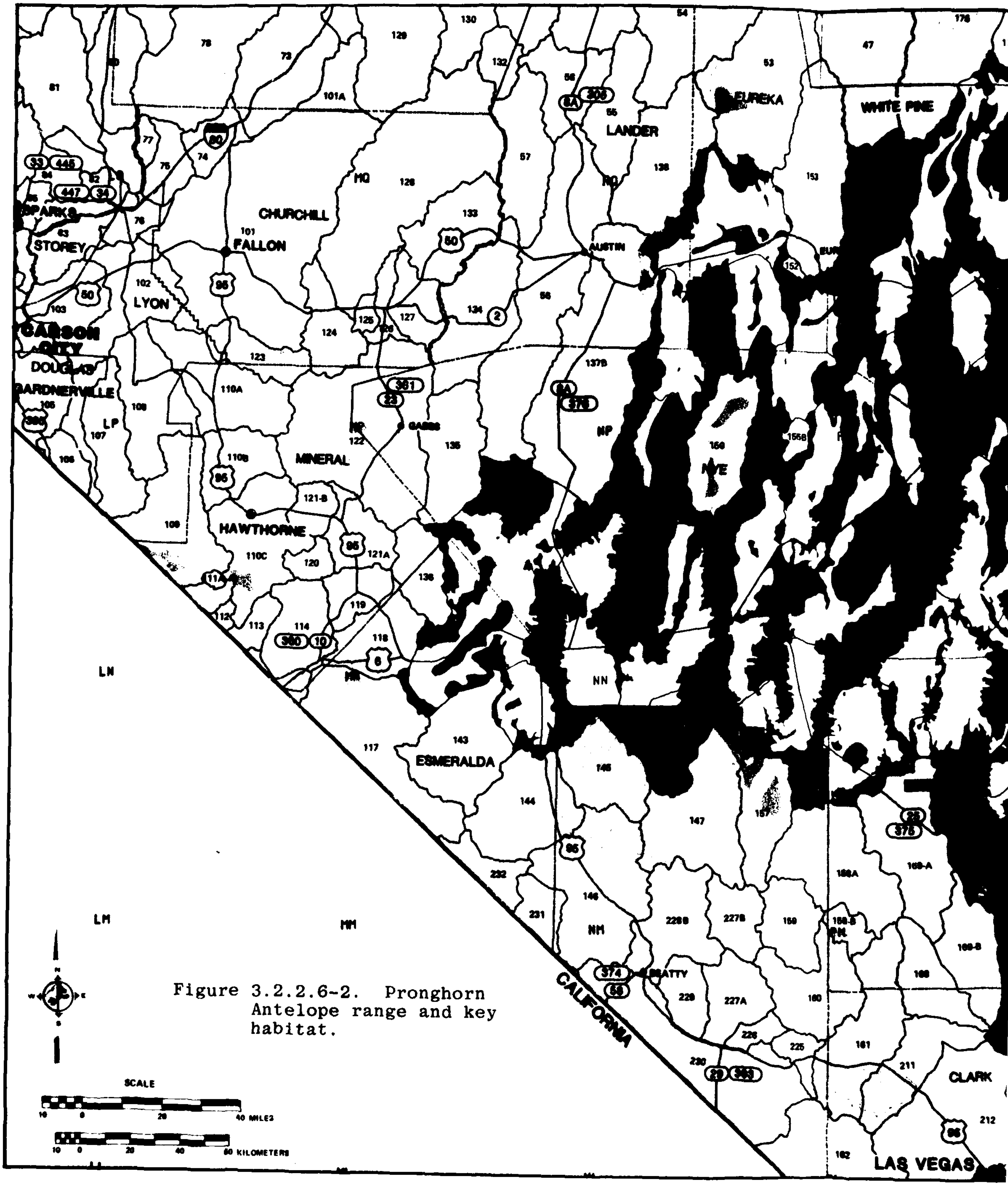
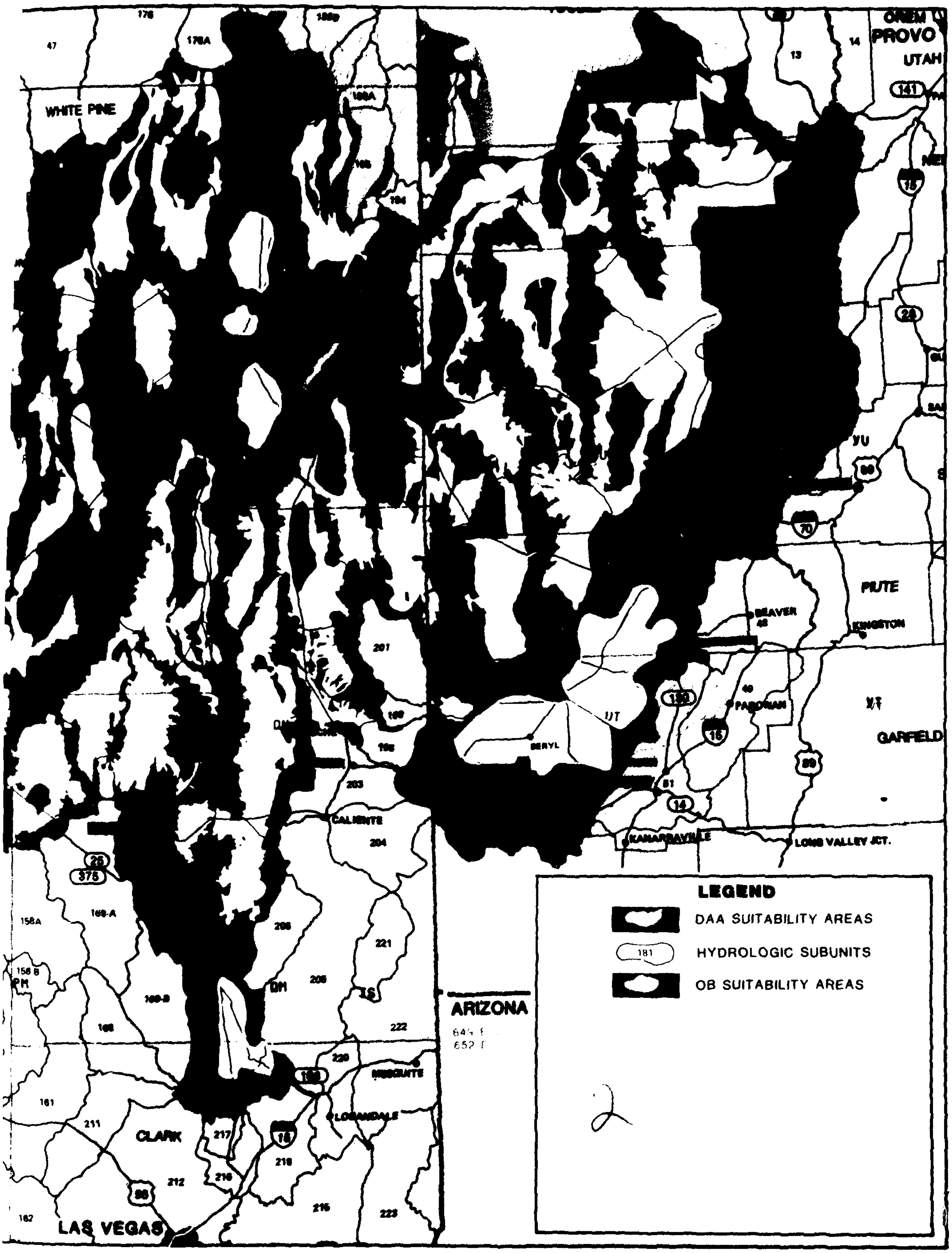


Figure 3.2.2.6-2. Pronghorn Antelope range and key habitat.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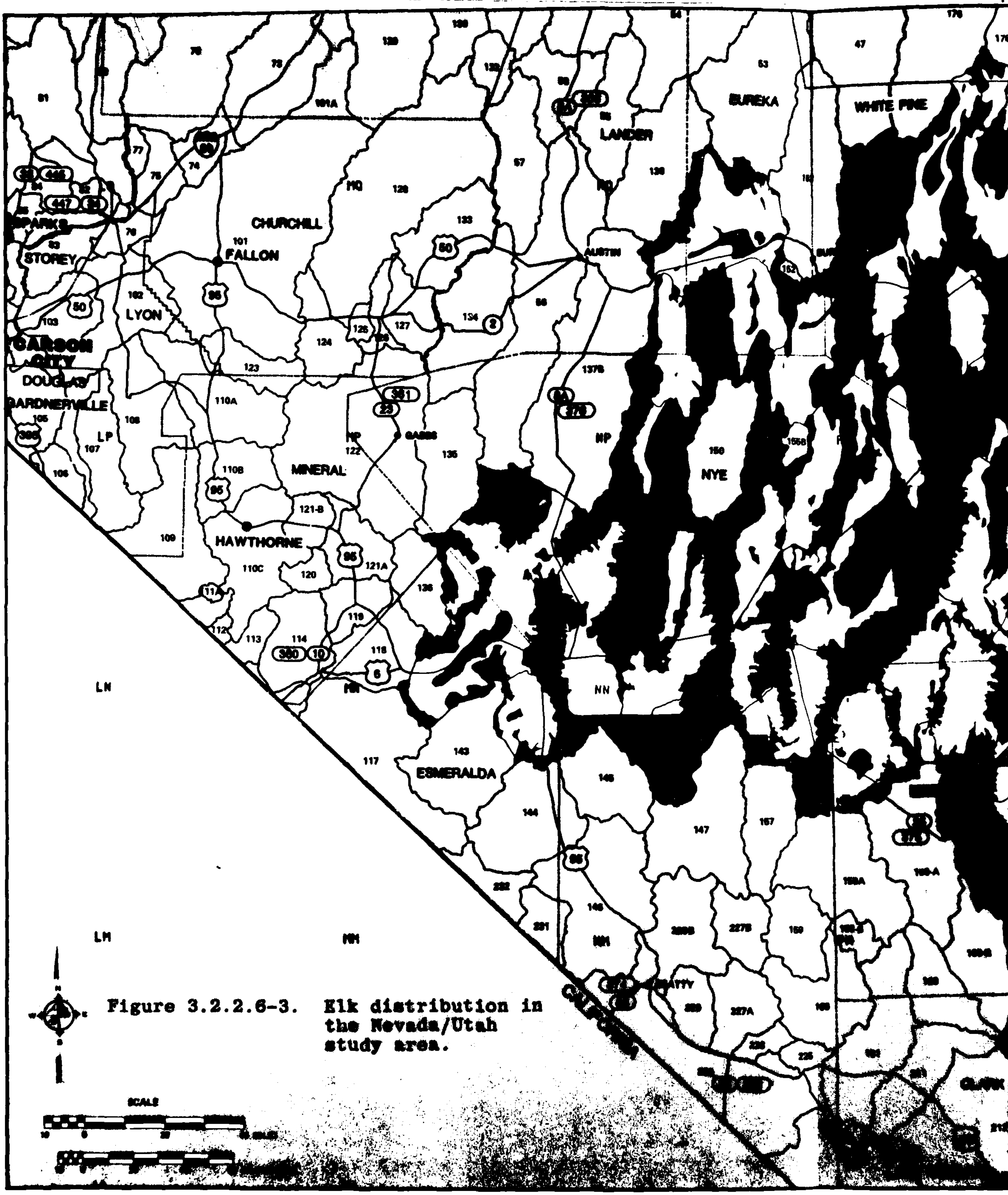
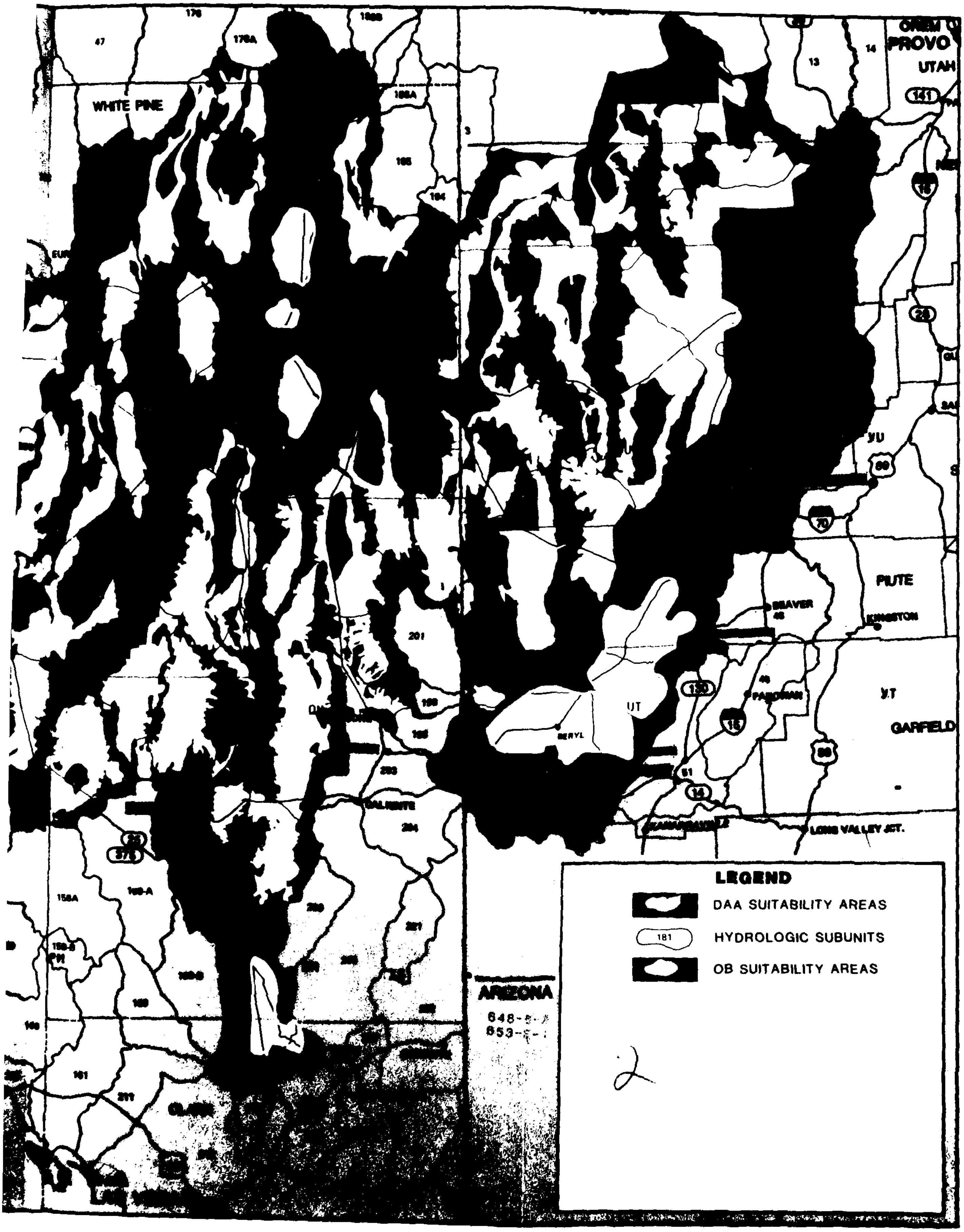


Figure 3.2.2.6-3. Elk distribution in the Nevada/Utah study area.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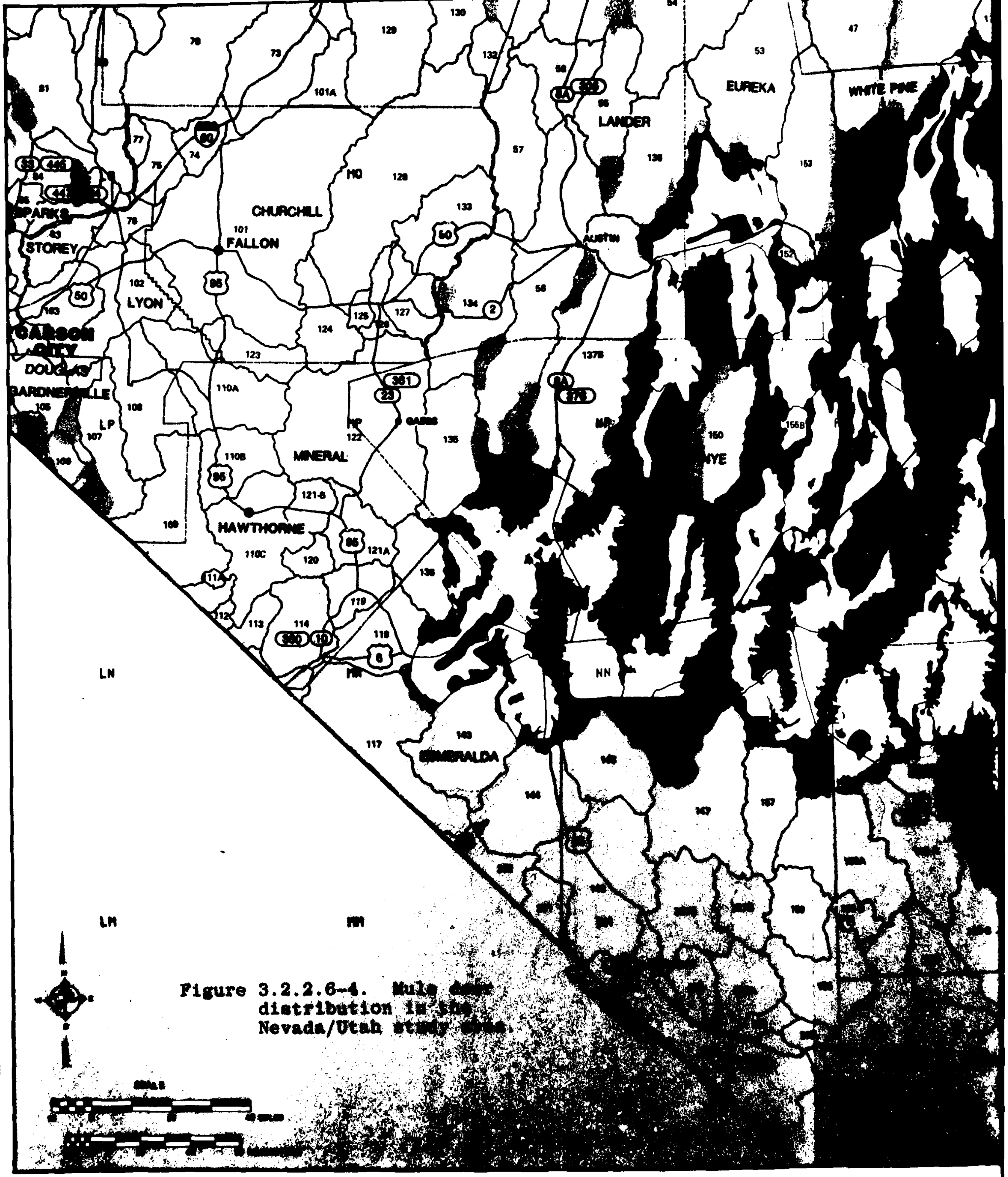
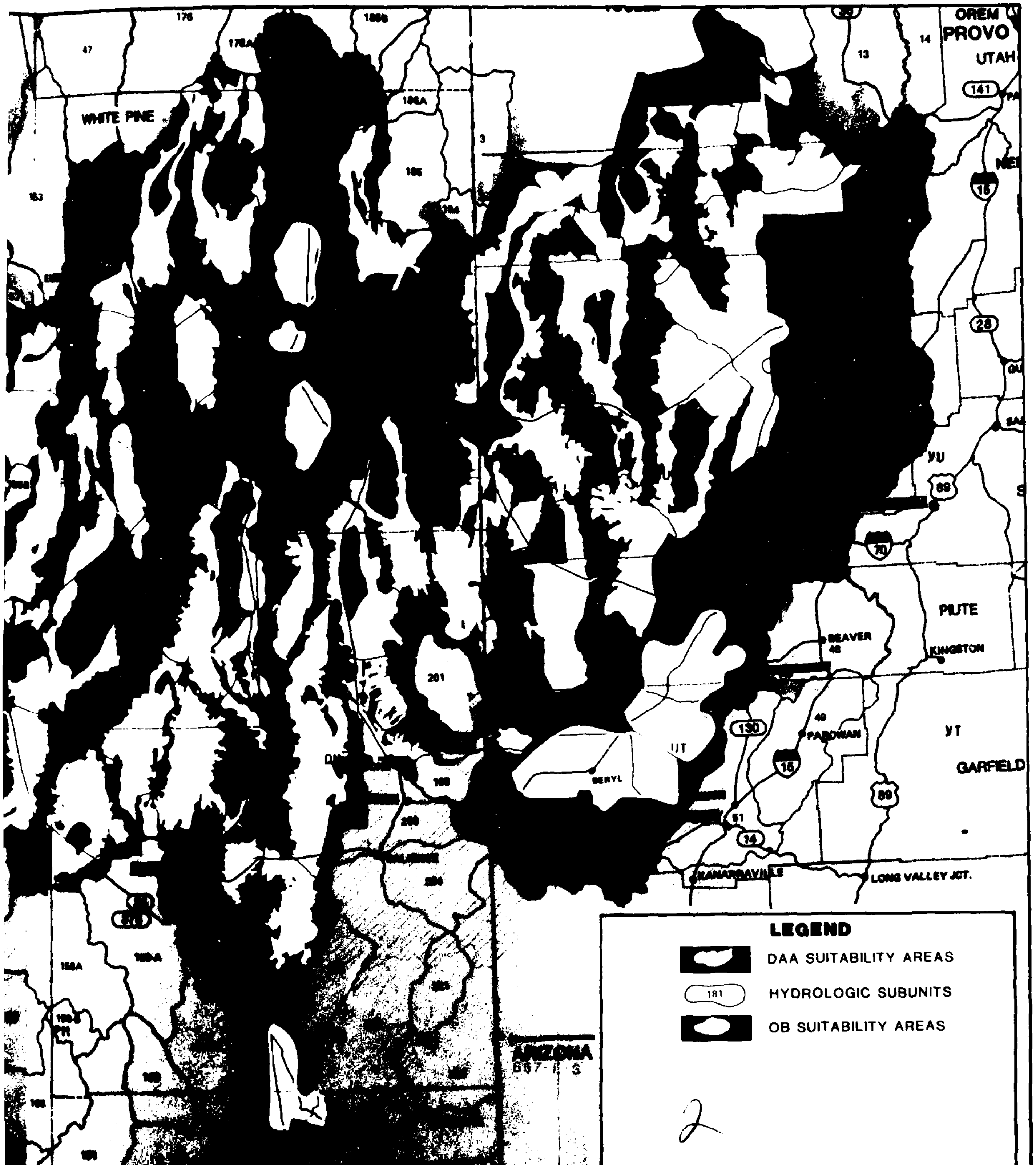


Figure 3.2.2.6-4. Mule deer distribution in the Nevada/Utah study area.



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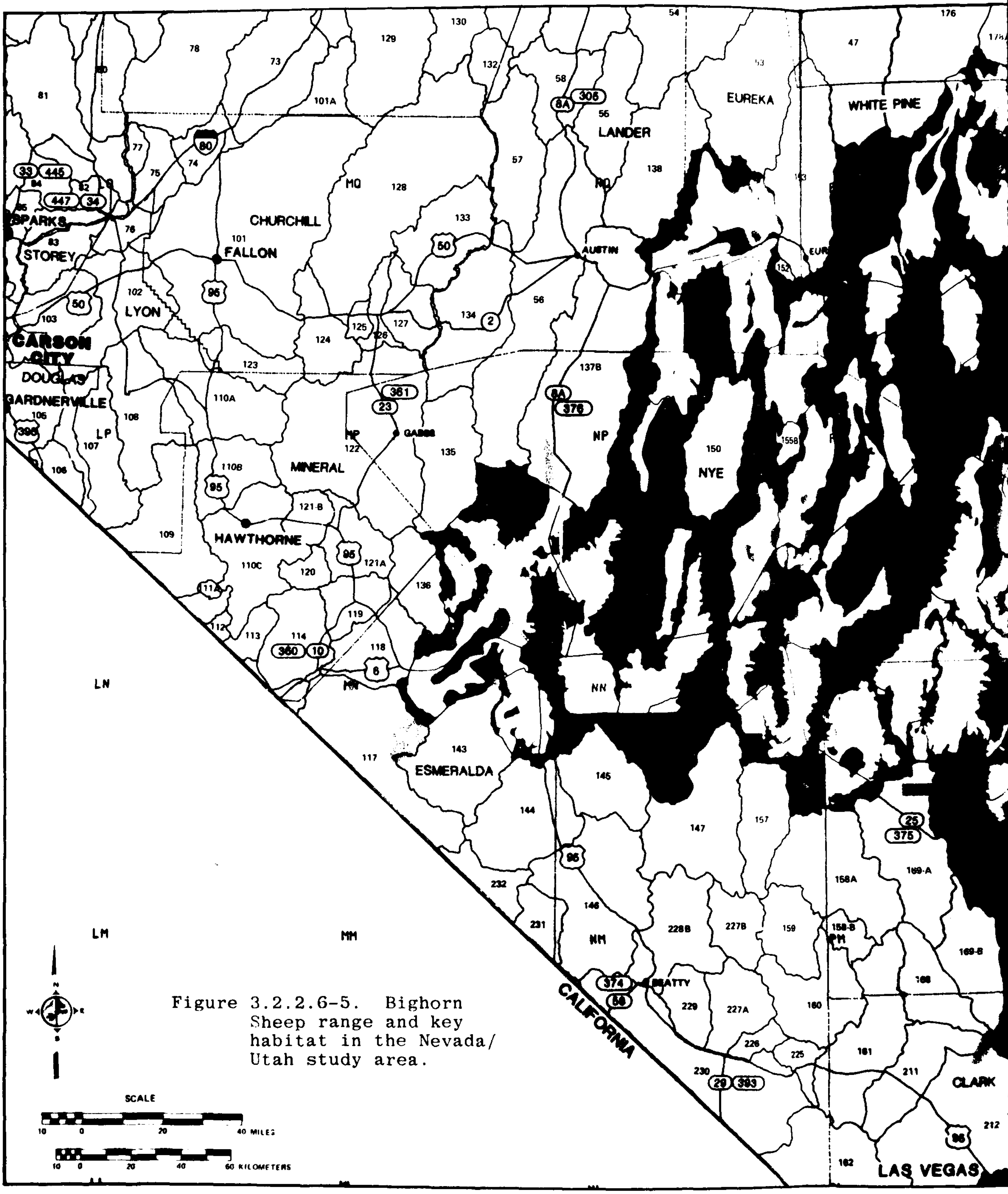
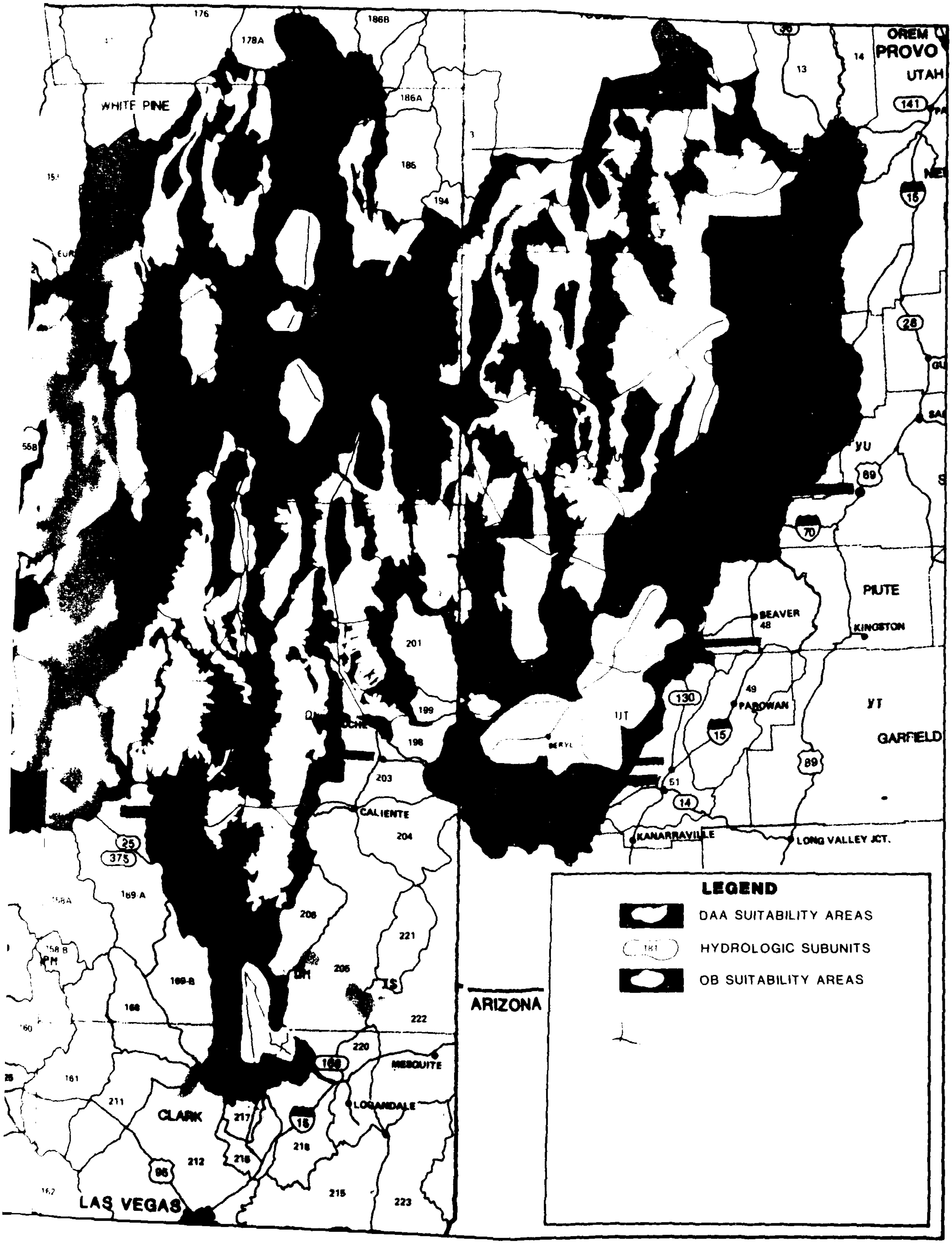


Figure 3.2.2.6-5. Bighorn Sheep range and key habitat in the Nevada/Utah study area.



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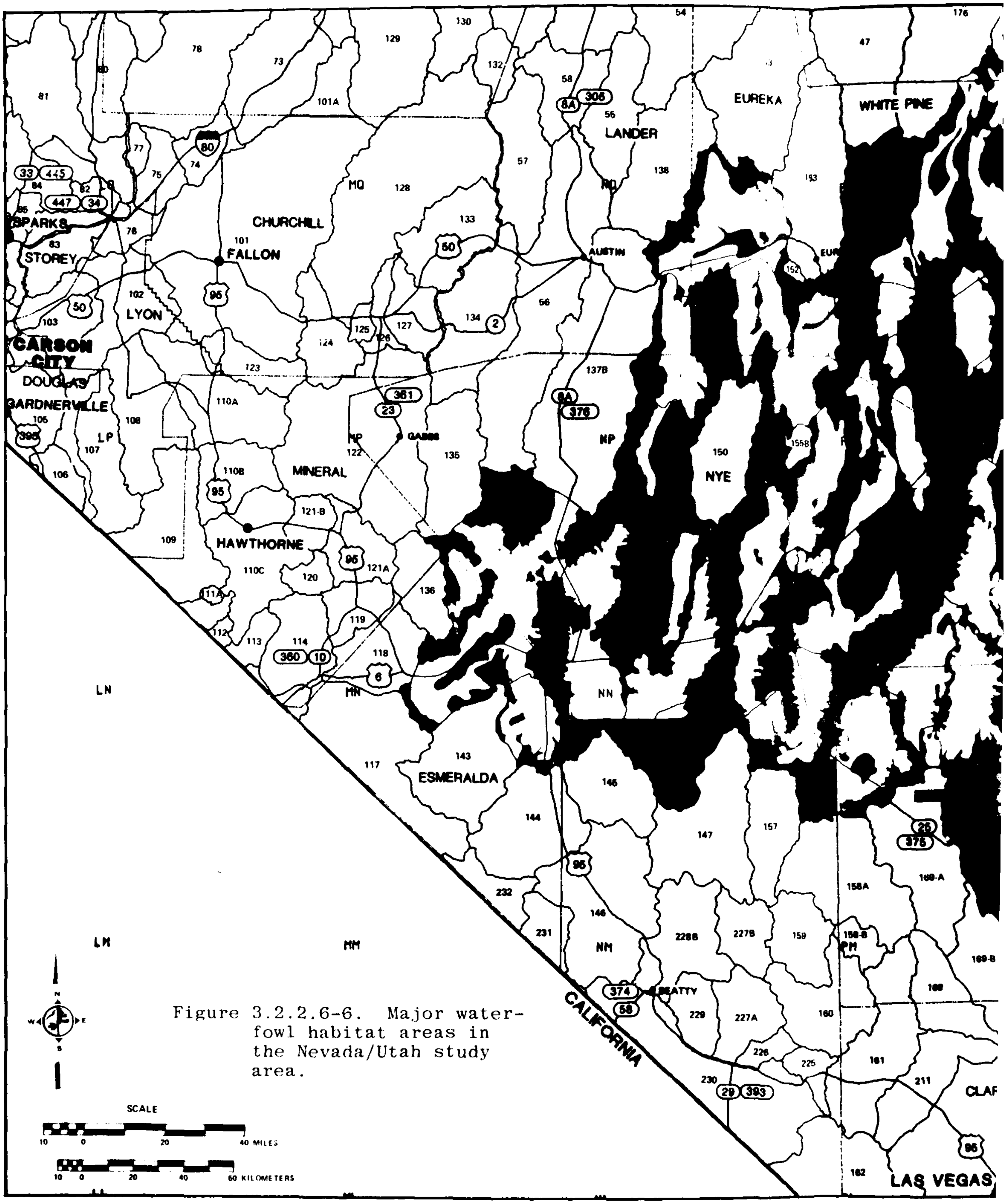
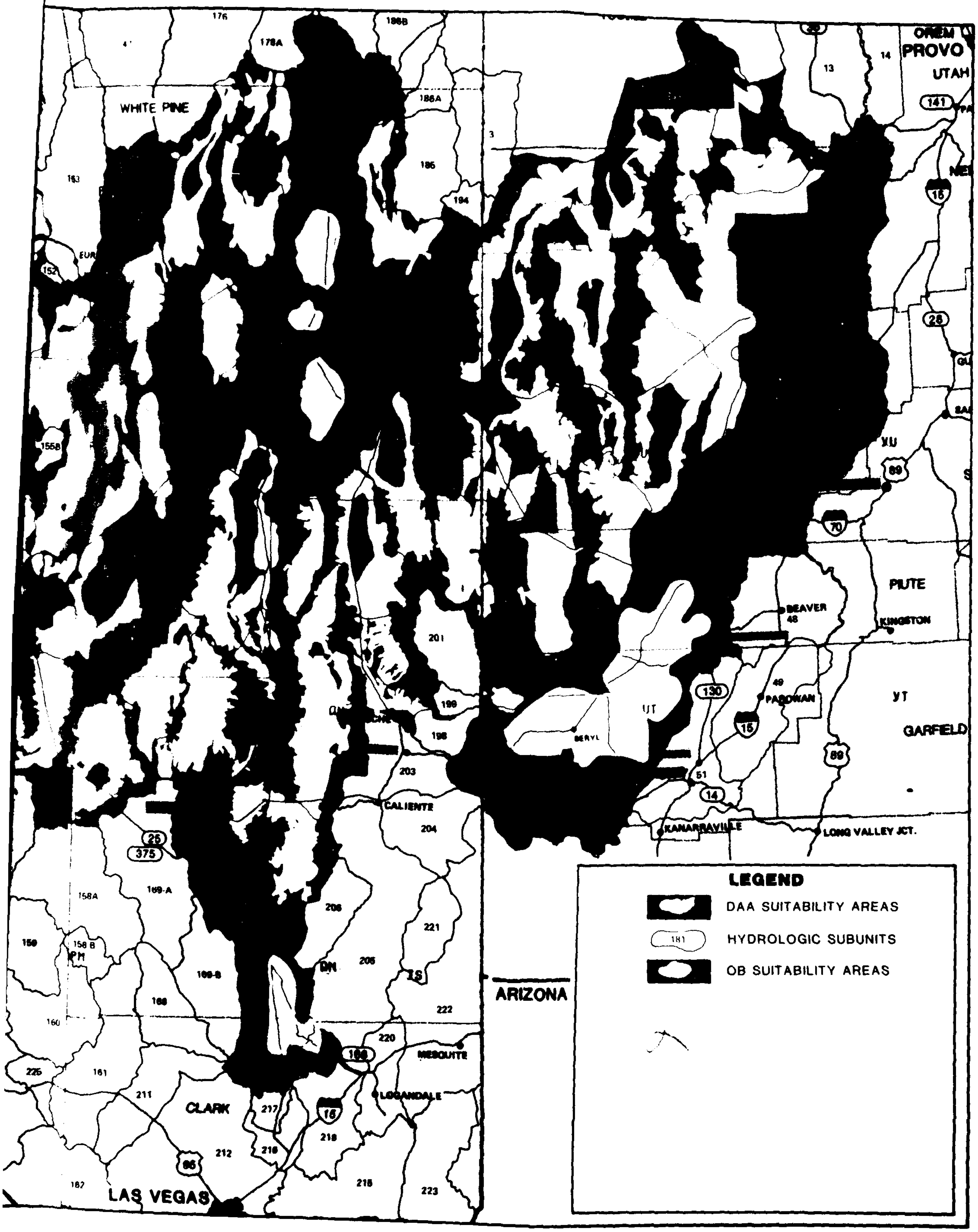


Figure 3.2.2.6-6. Major waterfowl habitat areas in the Nevada/Utah study area.



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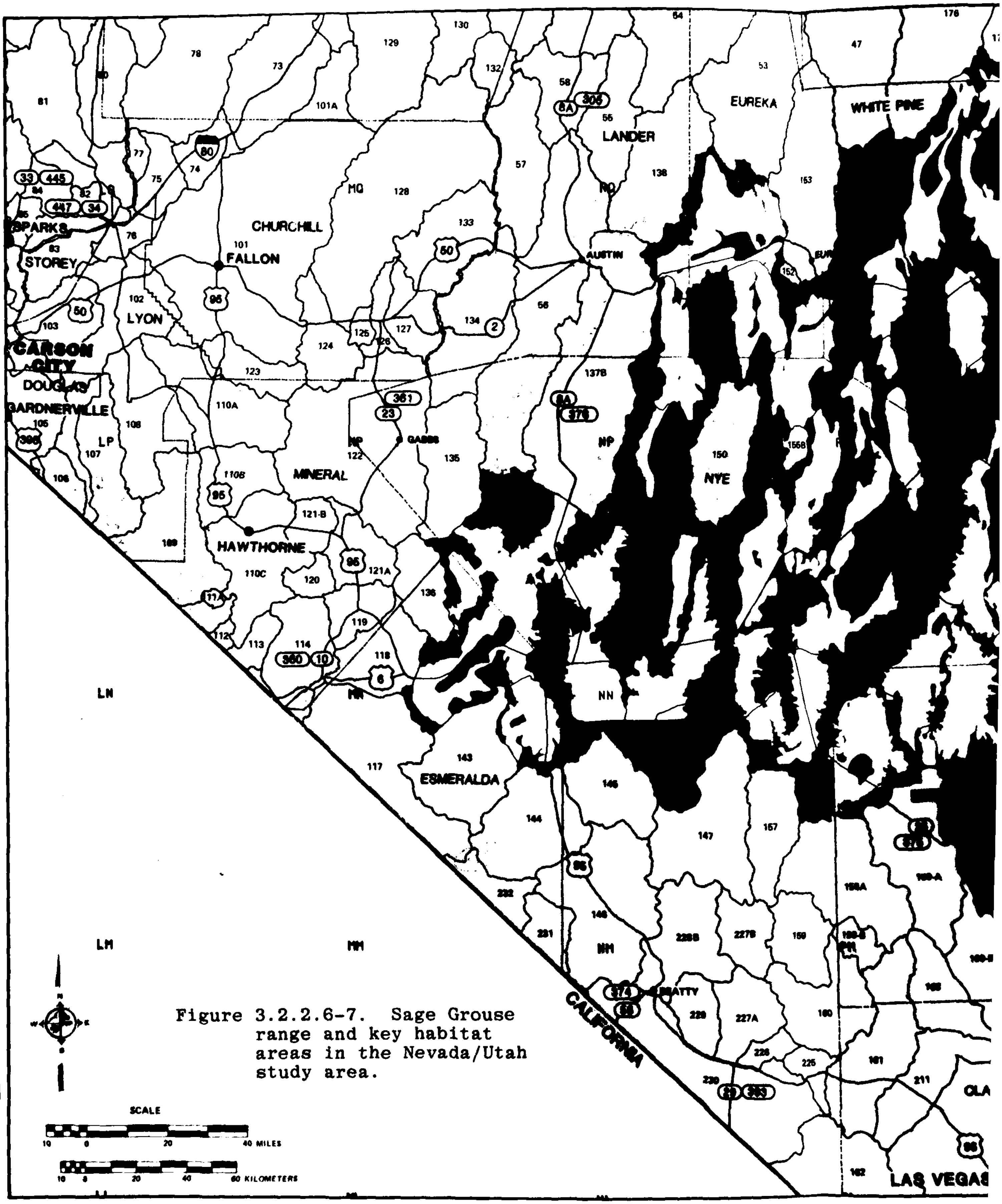
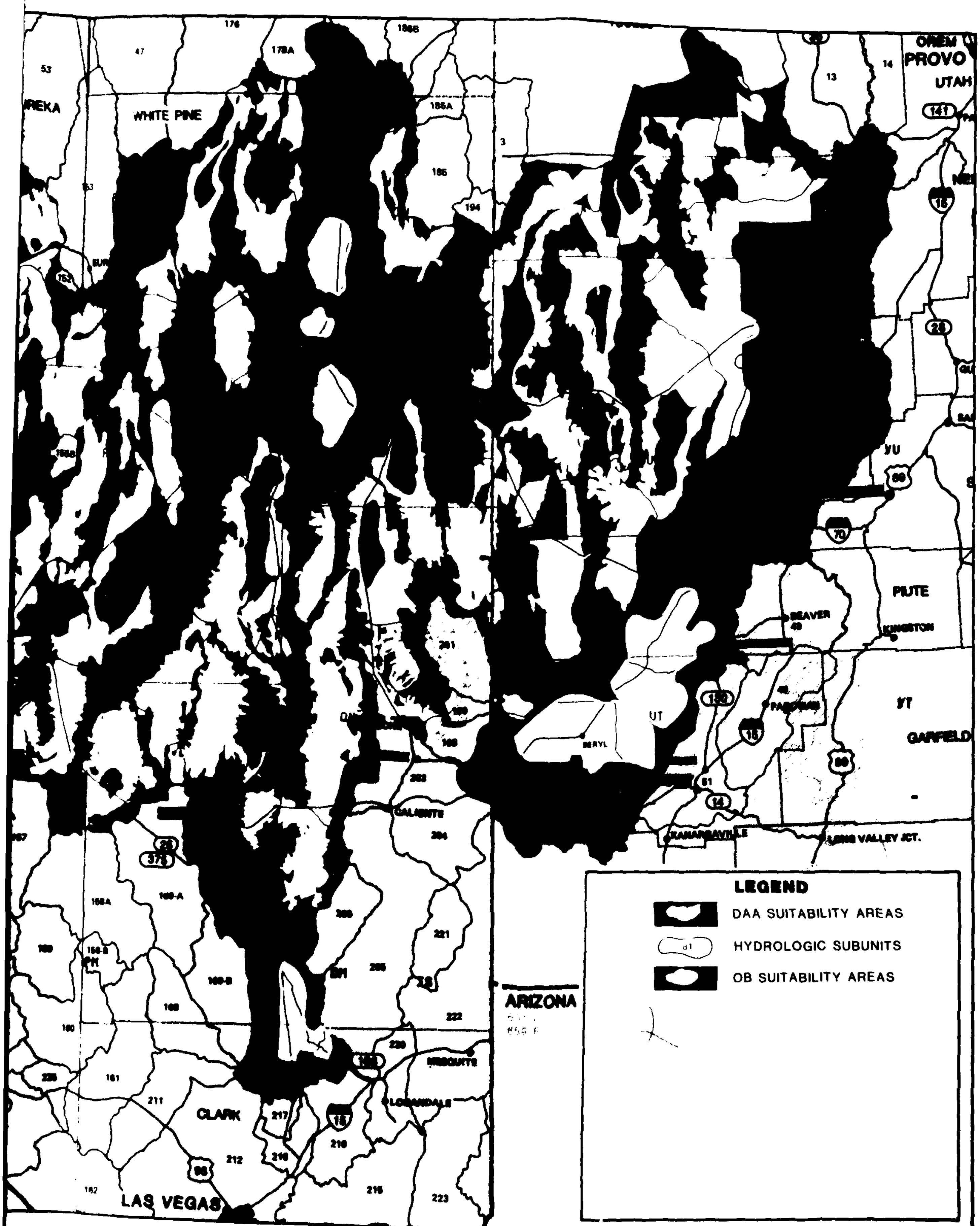


Figure 3.2.2.6-7. Sage Grouse range and key habitat areas in the Nevada/Utah study area.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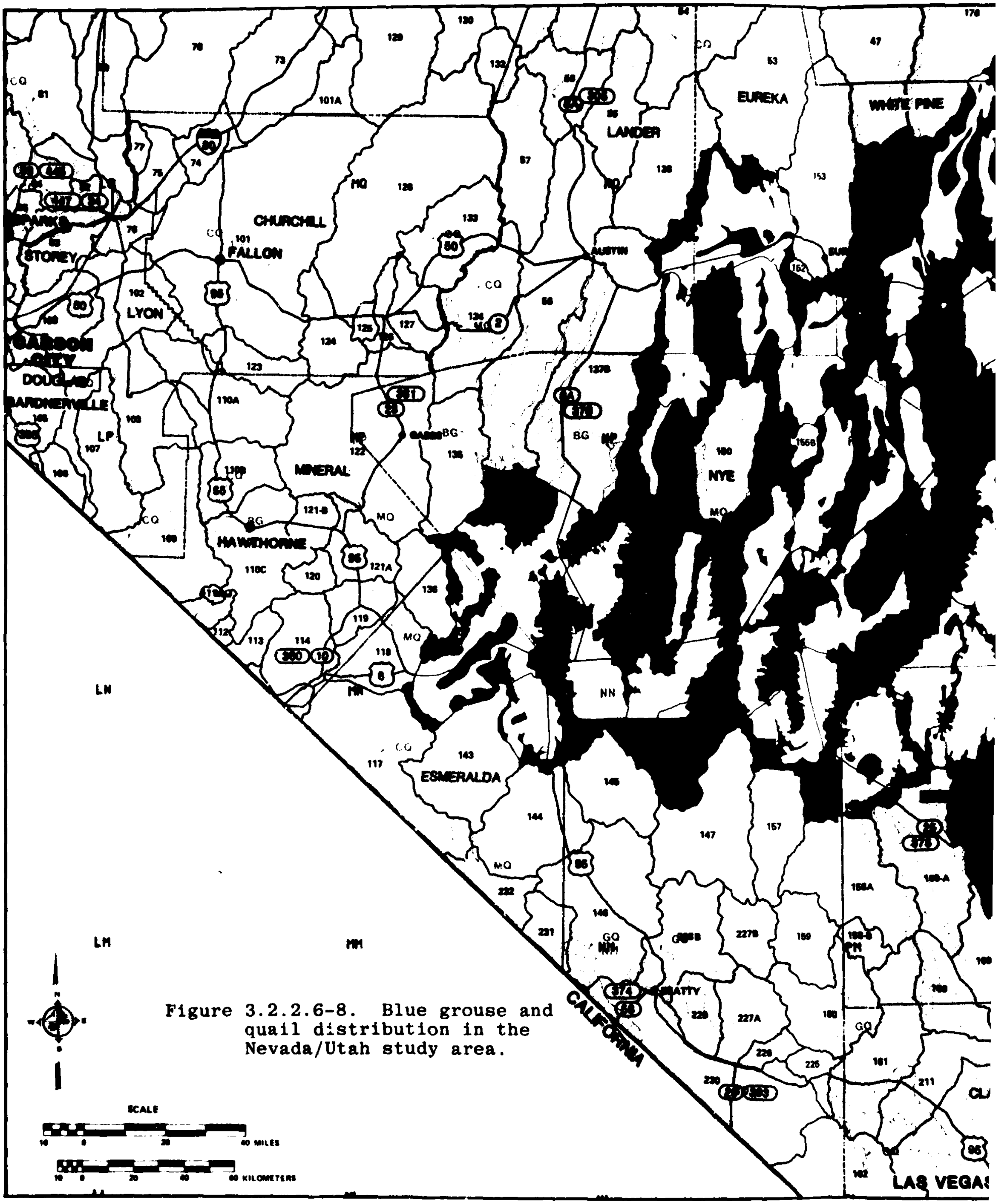
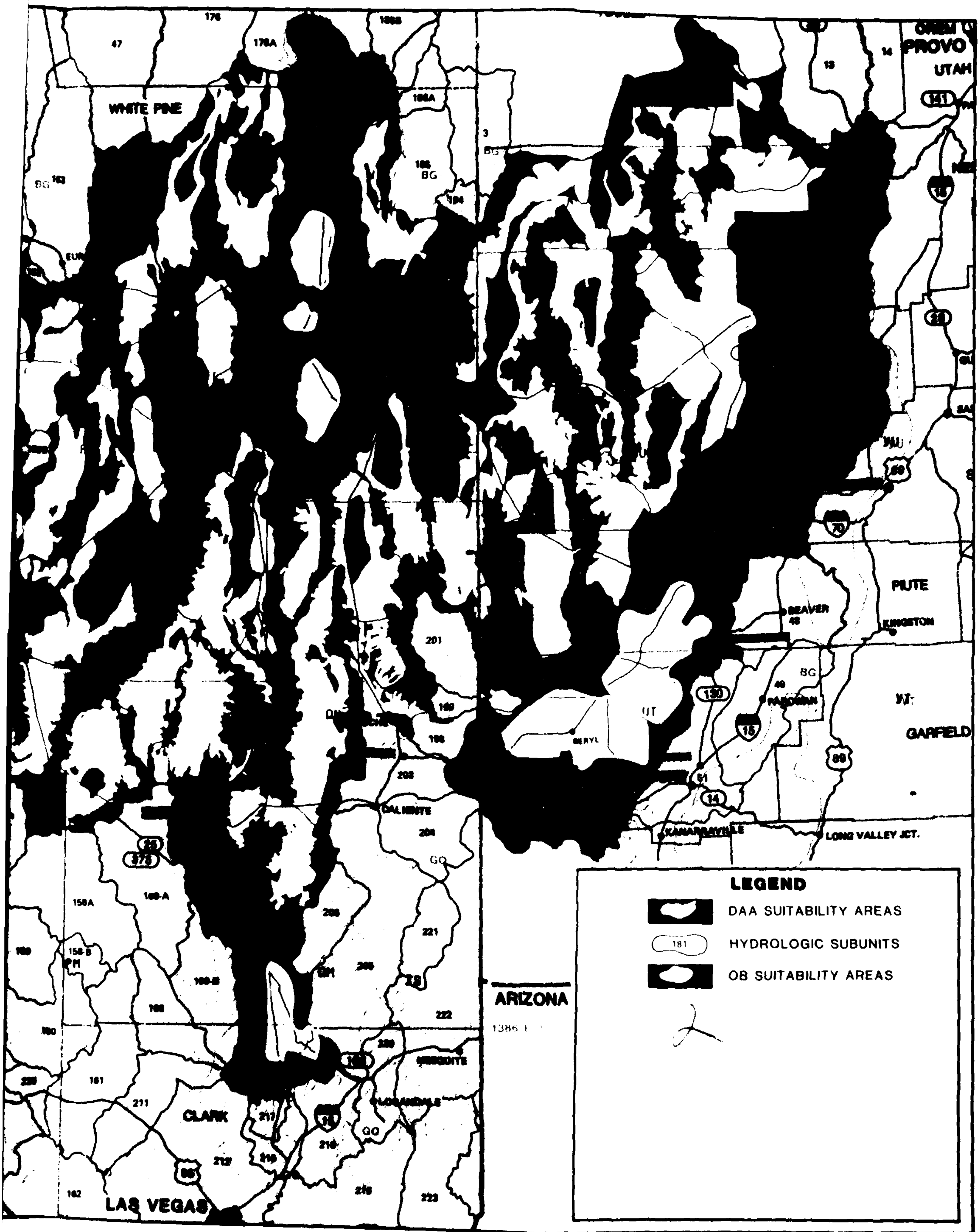


Figure 3.2.2.6-8. Blue grouse and quail distribution in the Nevada/Utah study area.



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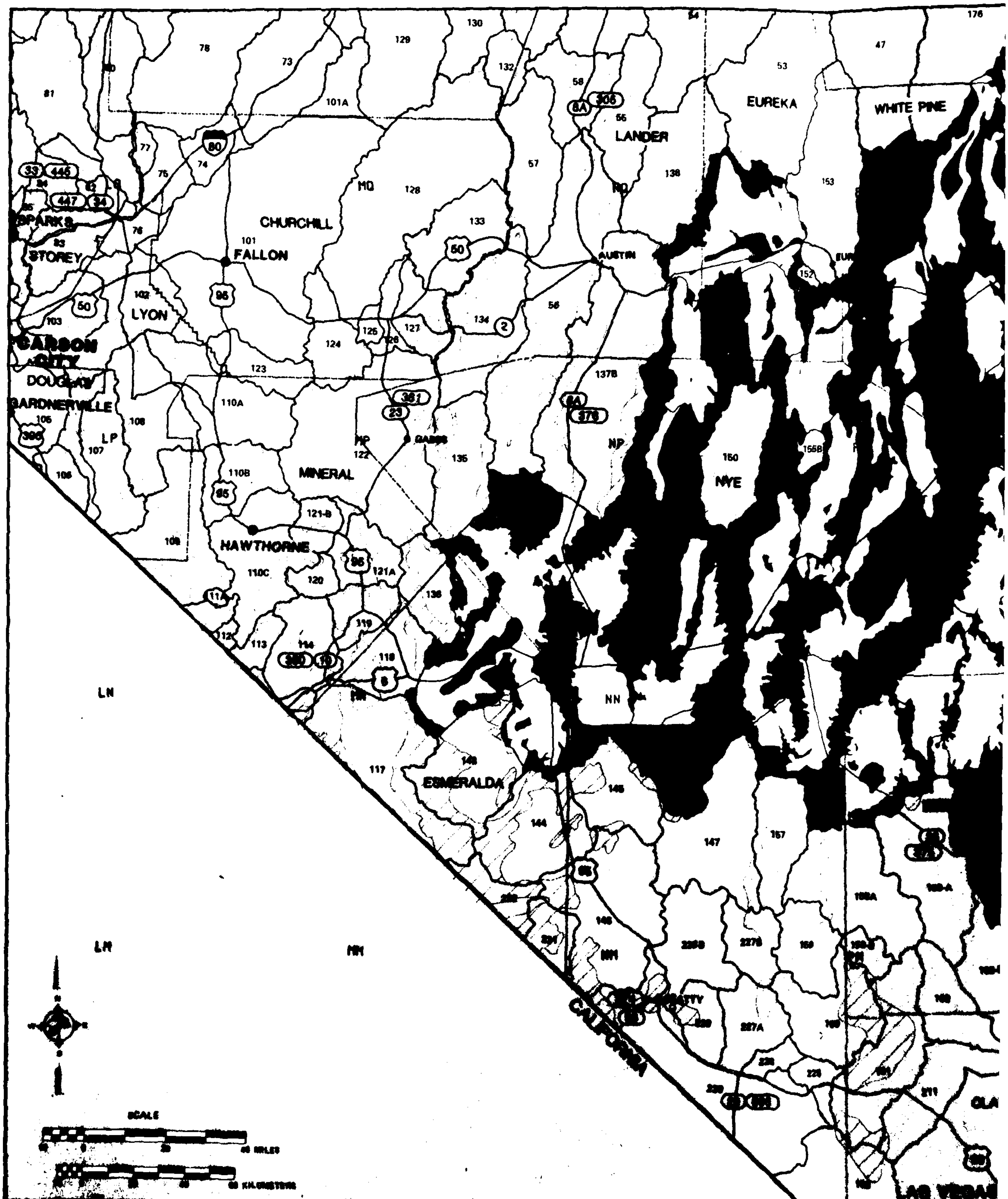

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STOREY
SPARKS
CARSON CITY
DOUGLAS
GARDNERVILLE
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HAWTHORNE
ESMERALDA
LANDER
AUSTIN
EUREKA
WHITE PINE
NYE
CALIFORNIA
BEATTY
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SCALE
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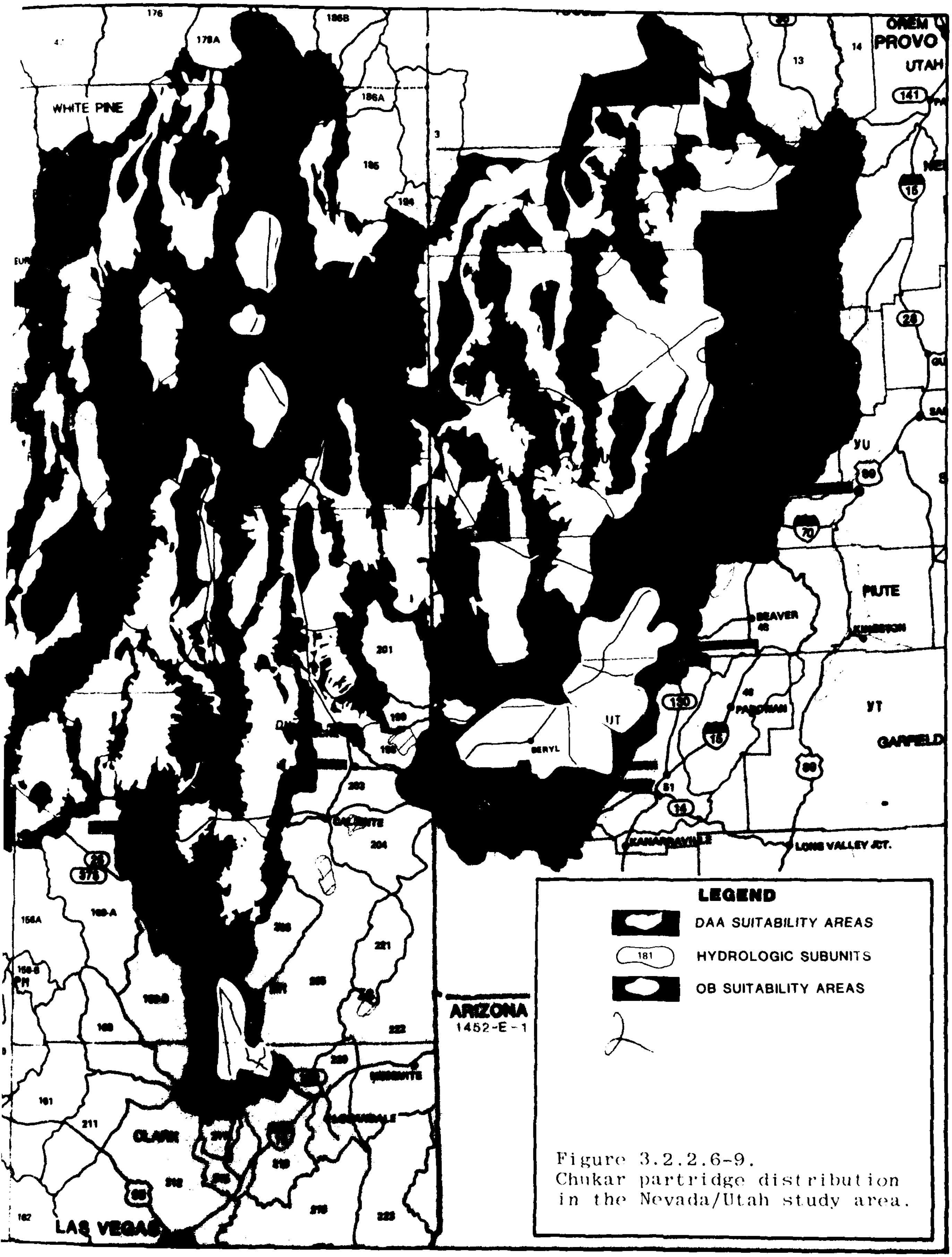

Figure 3.2.2.6-9.
Chukar partridge distribution in the Nevada/Utah study area.

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LEGEND

MAJOR WETLANDS AND RIPARIAN HABITAT

WATER BODY

WATER COURSE WITH FLOW DIRECTION INDICATED

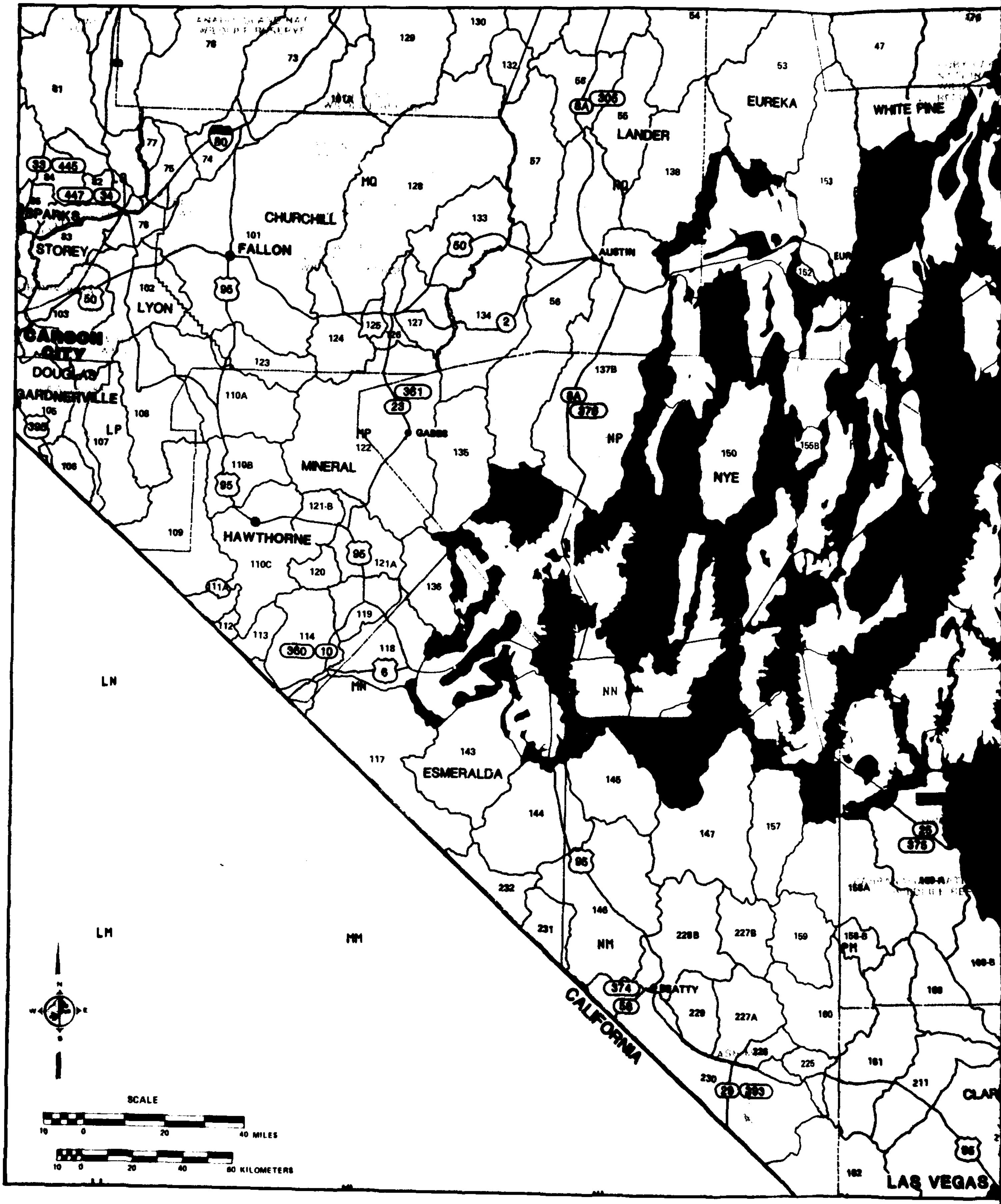
INTERMITTENT WATER COURSE

INTERMITTENT WATER BODY

MARSH

SPRING

WMA WILDLIFE MANAGEMENT AREA



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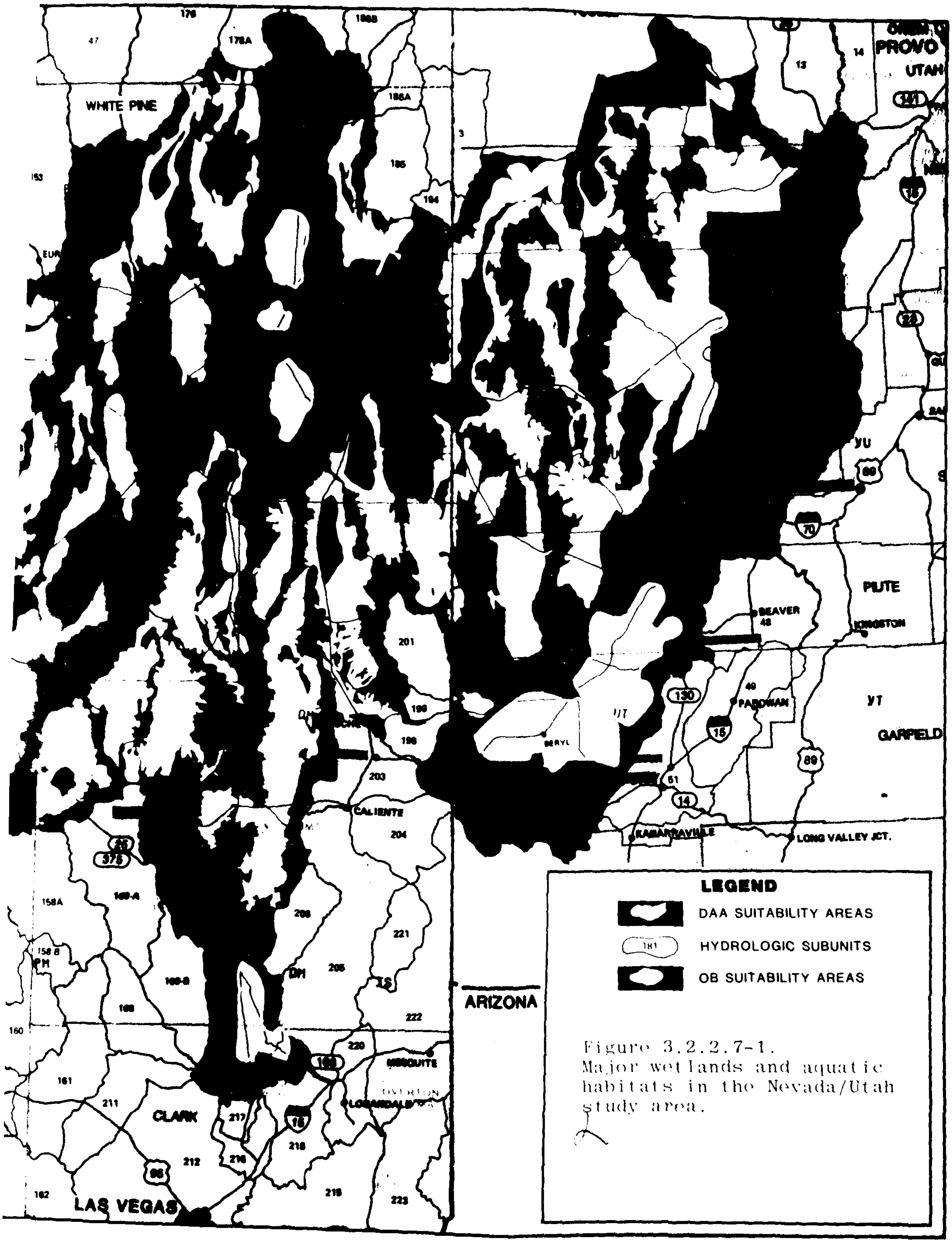

Figure 3.2.2.7-1.
Major wetlands and aquatic habitats in the Nevada/Utah study area.

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Table 3.2.2.7-1. Fish of Nevada/Utah study area.

SPECIES NAME	COMMON NAME
Family *CLUPEIDAE*	Shad and Herring
Dorosoma petenense atchafalayae	Mississippi Threadfin Shad
Family *SALMONIDAE*	Salmon, Trout, Grayling, and Whitefish
Oncorhynchus tsawytscha	King Salmon
O. nerka kennalyi	Kokanee Red Salmon
Salvelinus namaycush	Lake Trout
S. fontinalis	Brook Trout
S. malma	Dolly Varden Trout
Salmo clarki	Cutthroat Trout
S. c. henshawi	Lahontan Cutthroat Trout
S. c. pleuriticus	Colorado Cutthroat Trout
S. c. utah	Utah Cutthroat Trout
S. c. lewisi	Yellowstone Cutthroat Trout
S. c. ssp.	Humboldt Cutthroat Trout
S. gairdneri	Rainbow Trout
S. g. irideus	Southcoast Rainbow Trout
S. g. kamloops	Kamloops Rainbow Trout
S. g. regalis	Tahoe Rainbow Trout
S. g. smaragdus	Pyramid Rainbow Trout
S. aguabonita	Golden Trout
S. trutta	Brown Trout
Thymallus arcticus	Arctic Grayling
Prosopium williamsoni	Mountain Whitefish
P. gemmiferum	Bonneville Cisco
P. spilonotus	Bonneville Whitefish
P. abyssicola	Bear Lake Whitefish
Family *ESOCIDAE*	Pike
Esox lucius	Northern Pike
Family *CATOSTOMIDAE*	Suckers
Pantosteus lahontan	Lahontan Mountainsucker
P. intermedius	White River Mountainsucker
P. platyrhynchus	Bonneville Mountainsucker
P. clarki	Desert Sucker
P. delphinus	Bluehead Sucker
P. virescens	Green Sucker
Catostomus macrocheilus	Biglip Sucker
C. columbianus	Bridgelip Sucker
C. ardens	Utah Sucker
C. latipinnus	Flannelmouth Sucker
C. tahoensis	Tahoe Sucker
Castostomus (Chasmistes) cujus	Cui-ui Lakesucker
C. liorus	June Sucker
Castostomus clarki intermedius	White River Desert Sucker
C. fecundus	Webug Sucker
C. commersoni	White Sucker
Xyrauchen texanus	Razorback Sucker
Family *CYPRINIDAE*	Carp and Minnows
Ptychocheilus oregonensis	Northern Squawfish
P. lucius	Southern Squawfish (Colorado)
Acrocheilus alutaceus	Chiselmouth
Gila robusta	Colorado Gila
G. r. elegans	Swiftwater Colorado Gila
G. r. jordani	Pahranagat Roundtail Chub
G. r. seminuda	Virgin River Roundtail Chub
G. r. ssp.	Moapa River Roundtail
G. r. robusta	Roundtail Chub
G. atraria	Utah Gila
G. alvordensis	Alvord Gila
G. bicolor	Tui Chub
G. b. euchila	Fish Creek Tui Chub
G. b. isolata	Independence Valley Tui Chub
G. b. newarkensis	Newark Valley Tui Chub
G. b. obesa	Lahontan Valley Tui Chub
G. b. ssp.	Sheldon Tui Chub
G. cypha	Humpback Chub
G. elegans	Bonytail Chub
Iotichthys phlegethontis	Least Chub
Snyderichthys aliciae	Leatherside Chub
Richardsonius egregius	Lahontan Redshiner
R. balteatus	Columbia Redshiner
R. b. hydrophlox	Bonneville Columbia Redshiner
Family *CYPRINIDAE* (continued)	Carp and Minnows (continued)
Notemigonus crysoleucas	Golden Shiner
Notropis lutrensis	Red Shiner
N. stramineus	Sand Shiner
Rhinichthys osculus	Speckled Dace
R. o. robustus	Lahontan Speckled Dace
R. o. lethoporus	Independence Valley Speckled Dace
R. o. nevadensis	Ash Meadow Speckled Dace
R. o. oligoporus	Clover Valley Speckled Dace
R. o. moapae	Moapa River Speckled Dace
R. o. carringtoni	Snake River Speckled Dace
R. o. velifer	White River Speckled Dace
R. o. yarrowi	Virgin River Speckled Dace
R. o. ssp.	Meadow Valley Speckled Dace
R. cataractae	Longnose Dace
R. sp.	Bonneville Speckled Dace
Moapa coriacea	Moapa Dace
Eremichthys acros	Desert Dace
Relictus solitarius	Relict Dace
Cyprinus carpio	Asiatic Carp
Carassius auratus	Goldfish
Orthodon microlepidotus	Sacramento Blackfish
Lepidomeda albivallis	White River Spinedace
L. mollispinis mollispinis	Virgin River Spinedace
L. m. pratensis	Panaca Spinedace
L. altivelis	Pahranagat Spinedace
Plagopterus argentissimus	Woundfin
Pimephales promelas	Fathead Minnow
P. vigilax	Bullhead Minnow
Family *ICTALURIDAE*	North American Catfish
Ictalurus punctatus	Channel Catfish
I. catus	White Catfish
I. nebulosus	Brown Bullhead
I. melas	Black Bullhead
I. m. melas	Northern Black Bullhead
I. m. catulus	Southern Black Bullhead
I. natalis	Yellow Bullhead
Family *CYPRINODONTIDAE*	Killifish
Cyprinodon nevadensis	Amargosa Pupfish
C. n. pectoralis	Warm Springs Pupfish
C. n. mionectes	Ash Meadows Pupfish
C. diabolis	Devils Hole Pupfish
Crenichthys baileyi	White River Springfish
C. b. moapae	Moapa White River Springfish
C. b. grandis	Hiko White River Springfish
C. b. albivallis	Preston White River Springfish
C. b. thermophilus	Mormon White River Springfish
C. nevadae	Railroad Valley Springfish
Empetrichthys merriami	Ash Meadows Springfish
E. latos latos	Pahrump Killifish
Lucania parva	Rainwater Killifish
Fundulus zebrinus	Southwest Plains Killifish
F. kansae	Plains Killifish
Family *POECILIIDAE*	Topminnows
Gambusia affinis	Mosquitofish
Mollienesia latipinna	Black Molly
Xiphophorus helleri	Swordtail
X. maculatus	Moonfish
Family *PERCIDAE*	Perch
Perca flavescens	Yellow Perch
Stizostedion vitreum vitreum	Walleye
Family *CENTRARCHIDAE*	Sunfish
Archoplites interruptus	Sacramento Perch
Micropterus salmoides	Largemouth Bass
M. dolomieui	Smallmouth Bass
Morone saxatilis	Striped Bass
M. chrysops	White Bass
Lepomis macrochirus	Bluegill Sunfish
L. cyanellus	Green Sunfish
Pomoxis nigromaculatus	Black Crappie
P. annularis	White Crappie
Family *COTTIDAE*	Sculpins
Cottus beldingi	Belding (Piute) Sculpin
C. bairdi semiscaber	Bonneville Baird Sculpin
C. bairdi punctulatus	Colorado Mottled Sculpin
C. extensus	Bear Lake Sculpin
C. echinatus	Utah Lake Sculpin

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Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 1 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS OR REFERENCES
1	*Agave utahensis* Engelm. var. *eborispina* (Hester) Breitung	Ivory-spined Utah agave or pygmy agave	Agavaceae	T [illegible]	Southern Nye, Clark & Lincoln Cos. mostly in Desert Game Range	Typically on exposed outcrops or ridges of limestone mtn ranges [illegible] exposure slopes [illegible] crevices with *Gutierrezia microcephala*, *Eriogonum heermannii* var. [illegible], *Atriplex canescens*, *Ferocactus megalocephalus* var. [illegible] is threatened [illegible] and several spp. of [illegible]. Also in deep sand in a wash	[illegible]	May-June	Perennial. NV endemic. [illegible]
2	*A. u.* Engelm. var. *nevadensis* Engelm. ex. Greenm. & Roush	Utah agave	Agavaceae	T RC (NV)	Mojave Desert, San Bernardino Co., CA; Clark, NV; Washington Co., UT.	Dry, stony limestone slopes; shadscale scrub; Joshua Tree Wild.	[illegible]	May-July	A succulent perennial. Commercially exploited
3	*Angelica scabrida* Tukey and Mathias ex. Tukey	Charleston angelica	Apiaceae	T PT (NV)	Endemic to east slope of Charleston Mtns., Clark Co.	Gravelly soils in yellow pine belt with *Cercocarpus ledifolius* and *Pinus ponderosa*	[illegible]	July-August	Perennial. Heavy use recreation area. (27)
4	*Antennaria arcuata*	Arching pussytoes	Asteraceae	[illegible] PT (NV)	N. Nevada and Idaho. Four disjunct locations in Blaine Co., ID and Elko and Humboldt Cos., NV	Dry meadows	[illegible]	July	Perennial. (27)
5	*A. soliceps* Blake	Charleston pussytoes	Asteraceae	T PT NV	Endemic to Charleston Mtns., Clark Co. (Toiyabe NF).	Locally abundant on a ridge to Charleston Pk. on gravelly open slope with *Pinus aristata*	7744-[illegible]' [illegible] m	July-August	Perennial. (27)
6	*Arabis fisper* M.E. Jones	No common name	Brassicaceae	T RC (NV)	Endemic to S. NV-Eleana Range in NTS	Red-brown volcanic talus with Pinyon-juniper and *Artemisia nova*.	5800-6200' 1768-1890 m	April-June	Perennial from caespitose base.
7	*A. shockleyi* Munz	Shockley rockcress	Brassicaceae	T RC (NV) RD (UT)	Tooele Co., UT; Nye Co., NV & San Bern. Mtns., CA	Dry desert ranges with blacksage, *Cowania*, green ephedra and blackbush on limestone soils in ecologically stable areas with well established vegetation.	5250-6500' 1600-2000 m	May-June	Perennial, unusually disjunct locations.**
8	*Arctomecon californica* Torr. and Frem.	California or golden bearpoppy	Papaveraceae	E PT (NV) SE (NV)	Clark Co., S. NV & adj. Mohave Co., AZ.	On gypsum-rich soils derived from Muddy Ck. geologic formation with *Larrea-Ambrosia* and shadscale.	[illegible]-1900' 400-[illegible] m	April-May	An obligate gypsophile. ORVs are a threat.**
9	*A. humilis* Coville	Coville bearpoppy	Papaveraceae	E PT NV RE (UT) PE	Washington Co., UT close to NV border Mohave Co., AZ	Moenkopi formation, on alluvium & sandy clay soil, rolling low hills, bluffs, warm desert shrub community, open desert	2310-3000' 702-915 m	April-May	Endemic to Dixie corridor & Moenkopi soils. Sp. should be searched from similar habitats
10	*A. merriamii* Coville	Merriam bearpoppy	Papaveraceae	S RC NV	Southwestern Clark & Nye Cos. NV & adj. CA	Dolomitic limestone outcrops of steep mtn ranges or flat patches of gravelly soil with shadscale, blackbush, & creosote bush. *Agave utahensis* var. *eborispina* also occurs with this species	[illegible]-4700' [illegible] m	Late April-June	
11	*Arenaria kingii* (Wats.) Jones var. *rosea* Mag.	Rosy King sandwort	Caryophyllaceae	T PT (NV)	Known only from the Charleston Mtns.	On rocky limestone soils with ponderosa and limber pine and in yellow pine belt.	5900-8528' 1800-2600 m	June-August	(27)
12	*A. stenomeres* Eastw.	Steno sandwort	Caryophyllaceae	T RT (NV) RD (UT) SE (NV)	Lincoln Co. (known only from type location)	On limestone cliffs in a canyon at the south end of Meadow Valley Range.		May-June	(27)

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 2 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
[illegible]	Artemisia [illegible] Blake [illegible]	Fuzzy [illegible]	Asteraceae	[illegible] RT NV	[illegible] & [illegible] Co. [illegible] Elder, [illegible] Owyhee Desert Region, [illegible] northern NV	[illegible] alkaline flats, edges of mtn meadows & sage-brush-juniper slopes		June-[illegible]	Recently found in NV [illegible]
[illegible]	Astragalus [illegible] Barneby	[illegible] milk-[illegible]	Asteraceae	[illegible] RT NV	Nye, Esmeralda, and Lander Cos.	Restricted [illegible] low alkaline & barren [illegible] [illegible] in the valleys of this region with [illegible] [illegible], shad-scale, Sarcobatus, Tetradymia glabrata, Ceratoides lanata & Artemisia spinescens	1800-[illegible] ([illegible] 2140 m	May-June	Known from [illegible] [illegible] threat [illegible]
	Astragalus [illegible] ampullarius [illegible]	[illegible] milk-vetch	Fabaceae	[illegible] RT NV	Endemic to the Charleston Mtns. [illegible] Co. NV	Calcareous gravel flats & open ridges often sheltering under low sagebrush with pinyon-juniper [illegible] lower edge of yellow pine belt	[illegible] ([illegible] [illegible] m	May-June	[illegible] area [illegible]
[illegible]	A. [illegible]ensis M. E. Jones	[illegible] milk-vetch	Fabaceae	[illegible] RT NV	Humboldt Co. NV, Harney & Malheur Cos. Oregon	Barren knolls, bluffs, hillsides of loose sandy soils of volcanic origin	400-5000' (122-1524 m	May-June	[illegible]
[illegible]	A. ampullarius Wats.	[illegible] milk-vetch	Fabaceae	[illegible] RT UT	Kane & Washington Cos. UT, Coconino & Mohave Cos. AZ	Chinle & Tropic shale formations, clay soils, mixed desert shrub & scattered juniper community	3200-[illegible] ([illegible] m	[illegible] May	Mineral exploration is a threat [illegible]
[illegible]	A. beatleyae Barneby	Beatley milkvetch	Fabaceae	I	RT NV, [illegible] NV	Central Nye Co. endemic [illegible] NTS	On open flat areas with shallow volcanic soils, volcanic outcrops with black sage and pinyon-juniper	5600-6200' ([illegible]-1890 m	May-August	[illegible]
[illegible]	A. [illegible] Barneby	[illegible] milkvetch	Fabaceae	[illegible] Bird [illegible] for [illegible] listing	RT NV, RT UT	NE Nye Co. [illegible] NV & Millard Co. UT	Bare open places or semi stabilized sand dunes, deep sandy soils of valley floors, desert shrub community	[illegible]	Late May-June	[illegible]
[illegible]	A. [illegible]osus [illegible] var. [illegible] Rydb. Barneby	[illegible] Three milk-vetch	Fabaceae	[illegible]	RT NV	NE Nye [illegible] Eureka [illegible] central NV	Open gravelly hill-sides in scattered pinyon-juniper on limestone soils	5600-6500' ([illegible]-2000 m	May-June	[illegible]
[illegible]	A. convallarius Greene var. [illegible] Barneby	Timber [illegible] vetch	Fabaceae	[illegible]	R NV, R UT	[illegible] Highland Range to Washington [illegible]	Gravelly & sandy clay hillsides with sage-brush & pinyon-juniper on limestone	6000-6500' ([illegible] m	May-June	[illegible]
[illegible]	A. desereticus Barneby	Deseret milkvetch	Fabaceae	Not listed	[illegible] UT	On hillsides, sage-brush & scattered pinyon-juniper community	[illegible]-650[illegible] ([illegible] m	May	Possibly extirpated as a result of over-grazing [illegible]
[illegible]	A. funereus [illegible]	Funeral milk-vetch or [illegible]	Fabaceae	[illegible] RT NV	[illegible] NV [illegible] near NV	Steep gravelly slopes or gravelly clay ridges among sage-brush and shadscale, cliff ledges or talus under cliffs, some-times on limestone	[illegible] ([illegible] m	March-May	[illegible]
[illegible]	A. [illegible] var. [illegible]	Three [illegible] [illegible] desert milk-vetch	Fabaceae	RT NV, [illegible]	[illegible] confluence of [illegible] Muddy and [illegible] rivers, Lake Mead Rec. Area [illegible] NV [illegible] Esmeralda [illegible] NV and [illegible] AZ	Sandy wash, disturbed soil with Larrea, Ambrosia & Krameria	[illegible] ([illegible] m	May-June	[illegible]
[illegible]	A. [illegible] [illegible]	[illegible] milk-vetch	Fabaceae	[illegible]	RT UT	Kane and Washington [illegible]	Moenkopi Formation sandy clay barrens, gravelly hillsides and knolls, pinyon-juniper and mixed desert shrub community	[illegible]	May-early June	[illegible]
[illegible]	A. [illegible] var. [illegible]	Broad [illegible] milkvetch	Fabaceae	[illegible]	R NV	White Pine [illegible] NV known from [illegible] Ranges and thought to be in Snake Range and [illegible] Peak	Limestone gravel slopes in timber [illegible] formation [illegible]	[illegible] m	May-[illegible]	One collection from Spring Valley near [illegible] and [illegible] [illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 3 of 16).

[illegible]	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
[illegible]	[illegible] var. [illegible] Barneby	[illegible] milkvetch	Fabaceae	[illegible]	[illegible] Paramint [illegible] and central Amargosa drainage basin, NV	[illegible]	[illegible]	April-June	ORV [illegible] threat** [illegible]
[illegible]	[illegible]	[illegible] milkvetch	Fabaceae	[illegible] NV [illegible] NV High priority for federal listing	[illegible] springs at [illegible] Mina [illegible] Mineral [illegible]	Moist [illegible] with grass [illegible] salt grass	[illegible]	Late April-mid May	Known [illegible] from [illegible] geothermal development threat [illegible]
[illegible]	[illegible] Barneby	Pearl [illegible] milkvetch	Fabaceae	[illegible]	[illegible]	Presumably sagebrush [illegible] community	[illegible] m	Late April-May	Land has been [illegible]
[illegible]	[illegible] Barneby	Navajo Lake milkvetch	Fabaceae	T	Iron & Kane [illegible] Navajo Lake	Wasatch Formation, lakeshore gravels & limestone breaks	[illegible] 400 m		Recreation threat [illegible]
[illegible]	A. mohavensis Wats. var. hemigyrus (Clokey) Barneby	[illegible] milkvetch	Fabaceae	T	Indian Springs and in Charleston Mtns., Clark Co. and in CA	Rocky slopes in canyons or on cliff ledges	[illegible] m	April-June	** [illegible]
[illegible]	A. musiniensis	Sheep Range milkvetch	Fabaceae	T	Known only from Desert Game Range	Desert foothills in mixed shrub type on limestone gravels.	[illegible]-5600'	Late April-early June	[illegible]
[illegible]	A. nyensis Barneby	Nye milkvetch	Fabaceae	[illegible]	Clark & [illegible] Nye Cos., NV, NTS, Indian Springs, Moapa & Lee Cyn. in Charleston Mtns.	Compacted calcareous alluvial desert pavement with large [illegible] with Larrea & Ambrosia, Lycium andersonii, & Polygala subspinosa var. heterorhyncha.	[illegible]-45[illegible]' [illegible]-1372 m	April-May	** [illegible]
[illegible]	A. [illegible] Barneby	Rydberg milkvetch	Fabaceae	E	[illegible]	Garfield & Piute Cos., UT	Tertiary igneous gravels, rocky clay soil, mtn woodlands or barrens, alpine meadows.	[illegible] m	[illegible] August	[illegible] land not in protect area [illegible]
14	A. [illegible] Wats var. [illegible] Barneby	Lee Canyon milkvetch	Fabaceae	T	RT NV PE UT	Known only from Charleston Mtns. Clark Co., NV	Slopes & benches in open yellow pine forest in gravelly soil derived from limestone	[illegible]-[illegible]' 2470-[illegible] m	May-[illegible]	Narrowly endemic [illegible]
[illegible]	A. [illegible] Wats. var. [illegible] Barneby	Spearcalyx egg milkvetch	Fabaceae	T	[illegible] NV [illegible] UT	Lincoln Co., NV, Iron & Beaver Cos., UT	Limestone mtns. sheltered by sagebrush on dry gravelly hillsides and stony flats.	[illegible]-6800' [illegible]-[illegible] m	May-July	Locally common [illegible] cattle** [illegible]
16	A. [illegible] Barneby	Ash Meadows milkvetch	Fabaceae	E	PE NV SE NV High priority for federal listing	Endemic to eastern portion of central Ash Meadows, Nye Co., NV	Restricted to flats & knolls of calcareous, alkaline soil in Ash Meadows with shadscale, Enceliopsis nudicaulis var. corrugata (threatened sp.) and saltgrass		April-May	ORV activity threat [illegible]
17	A. porrectus S. Wats	[illegible] milkvetch	Fabaceae	[illegible]	[illegible] NV	Known only from lower Humboldt & Truckee Valleys of Churchill, Pershing & S. Washoe Cos., NV	Gravelly washes & outwash fans in foothills of desert mtns. volcanic sand or rock debris	4300-5000' 1311-1524 m	May-June	Perennial, avoided by cattle [illegible]
18	A. pseudiodanthus Barneby	Tonopah milkvetch	Fabaceae	[illegible]	RT NV	Nye Co., Mono Co., CA	Deep sandy soils, drifting sands & alluvial soils with Sarcobatus baileyi, Atriplex spp., Hilaria jamesii, Tetradymia glabrata, Chrysothamnus spp.	5000-6800' 1524 m-[illegible] m	Early June	Known only from four localities. Prostrate perennial herb ** [25, 5]
19	A. pterocarpus M. E. Jones	Winged milkvetch	Fabaceae	T	RC(NV)	South central & SE Humboldt Co. to Lander Co., NV	Lowhills and alkaline sandy flats, saltgrass meadows and openings among halophytic shrubs	4450-4500' 1356-1372 m	May-June	** [illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 4 of 16).

No.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES*
39a	A. robbinsii var. occidentalis Wats.	Lamoille Canyon milkvetch	Fabaceae	E RT NV	Lamoille Cyn., Ruby Mtns., Elko Co., NV	On stream banks in moist loam soil under aspen in mtn brush type		July-August	[23]
40	A. serenoi (Kuntze) Sheld. var. sordescens Barneby	Dirty Sereno's milkvetch	Fabaceae	E RT NV	Nye Co.: Toiyabe N.F. - Toquima Range	Foothills on alkaline soil among low sage-brush and pinyon-juniper; ramifies through sagebrush on gentle slopes & flats in Ralston Valley	[illegible] (2170 m)	May-July	Known only from type locality [25, 33]
41	A. solitarius	Solitary milkvetch	Fabaceae	T (P) RE NV	N. Humboldt Co., NV	In sandy clay soil along the Owyhee River	[illegible]	June	[34]
42	A. striatiflorus M.E. Jones	Escarpment milkvetch	Fabaceae	E RT UT	Kane and Washington Cos., UT; Coral Pink Dunes Rec. Area; Coconino Co., AZ	Entrada & Navajo sandstone formations, blow sand, interdune valleys, sandy depressions on ledges, bars & terraces in stream channels	5000-6250' (1530-1900 m)		Rec. & ORV threat in Coral Pink Dunes [23]
43	A. tephrodes var. eurylobus	Peck Station or Needle Mtn. milkvetch	Fabaceae	RE NV	NE of Caliente, Lincoln Co., NV	In Needle Mtns. on pink sandstone or sandy soil derived from it			Not seen since 1945 in Needle Mountains ** [23]
44	A. toquimanus Barneby	Toquima milkvetch	Fabaceae	T RT NV	Nye Co., Toquima Range; known from Saulsbury Wash	On gravelly slopes in canyons, on limestone derived soils growing with Artemisia arbuscula and pinyon-juniper	7000' (2134 m)	April-July	[25]
45	A. uncialis Barneby	Currant milkvetch	Fabaceae	E RE NV (High priority for fed. listing)	Nye Co. foothills of White Pine & Pancake ranges	Bare knoll of stiff, alkaline clay derived from limestone	5300-6500' (1615-1981 m)	Early May	**, [23]
46	A. sp.	Osgood Mtns. milkvetch	Fabaceae		E. Humboldt Co. Restricted to the Osgood Mountains	No information available.			Found by M. Yoder-Williams, BLM, Winnemucca [32, 33, 34]
47	Brickellia knappiana E. Drew	Knapp brickellia	Asteraceae	T CA) RT NV)	Mojave R. & Panamint Mtns., CA, recently found in Clark Co., NV in the Desert NWR	Joshua Tree woodland	2500-3500' (762-1067 m)		[32, 33]
48	Calochortus striatus Parish	Streaked mariposa lily	Liliaceae	T RT NV	Mojave Desert from Rabbit Springs, CA to Las Vegas, NV	In low alkaline seeps & meadows about springs or in washes creosote bush scrub	2500-4300' (762-1311 m)	April-June	[22, 26]
49	C. sp.	Unnamed mariposa lily	Liliaceae	RE NV	Ash Meadows only				
50	Camissonia megalantha (Munz) Raven ssp. heterochroma	Cane Springs evening primrose	Onagraceae	E RC NV) PD UT)	Nye Co., known from NTS and Utah	Volcanic alkali soil, washes & talus slopes in Atriplex & A. hymenelytra	4050' (1235 m)	August-October	[33]
51	C. nevadensis Kell.	Nevada evening primrose	Onagraceae	E RC NV	West central NV: Washoe & Storey, N. Lyon, W. Churchill Cos., NV & CA	In sandy soils, with slight slope.	4500-5200'	Late April-June	[33, 21]
52	Castilleja parvula Rydb.	Tusher paintbrush	Scrophulariaceae	T RT UT	Piute and Beaver Cos., UT	Alpine vegetation on Tertiary igneous gravels.	10,000-11,600' (3050-3549 m)	Late July-August	[23]

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Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 5 of 16).

[illegible]	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES*
4	[illegible]	[illegible]	[illegible]	[illegible] High priority for federal listing	[illegible] known only from Monte Neva hot springs [illegible] Steptoe Valley	[illegible] where seepage water [illegible] with [illegible] Rhus [illegible] var. [illegible]	[illegible] m	[illegible] July	[illegible] of seepage flow [illegible] threat ** [illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV	Nye [illegible] Ash Meadows also known from Tecopa Springs, CA		[illegible] m	[illegible] Sept	Annual [illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV	Known only from Charleston Mtns Clark [illegible] NV	[illegible] gravelly slopes & moist creek bottoms	[illegible] 2430-[illegible] m		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV	[illegible] Nye [illegible] NV, Ash Meadows and Inyo [illegible] CA	[illegible] large alkaline flats in Ash Meadows [illegible] common [illegible]	[illegible] m	[illegible]	Annual [illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV	Clark, Nye, Lincoln Cos., NV; San Bern. Co., CA; Mohave Co., AZ; most locations in NTS	Dry ridges in pinyon-juniper and mtn mahogany, or with black-sage in shallow, well drained soils & rocky areas in dry bottoms, on mesas or on mtn tops. In Gold Meadows (NTS) it occurs with Trifolium andersonii var. beatleyae (a rare sp.). Assoc. spp include Artemisia & Atriplex, [illegible] [illegible] [illegible] same habitat.	[illegible] [illegible] 2744 m	June-July	Threatened by [illegible] difficult to separate from [illegible] desert. ** [illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV, [illegible] UT	Millard [illegible] UT [illegible] Desert Research Experimental Station	Sevy Dolomite Formation, gravelly [illegible] open slopes & ridges [illegible] covered with shallow soil layer. Desert shrub & grassland community with Eriogonum eremicum, Sphaeralcea caespitosa, Penstemon nanus & other restricted species	[illegible] 2483 m	May-Early June	** [illegible]
	[illegible]	[illegible]	[illegible]	[illegible] NV	Mineral [illegible] NV & Inyo [illegible] CA; endemic to White Mtns & Inyo Mtns	Open slopes of rock & gravel in pinyon-juniper & bristlecone pine; wide elevational range	6000-9000' (1830-2743 m)		** [illegible]
	[illegible] Ma Br [illegible]	Las Vegas [illegible]	Boraginaceae	[illegible] NV, [illegible] NV	[illegible] from [illegible] Las Vegas [illegible] NV (Clark & Lincoln Cos.)	Gravel fans & alkaline clay hills in Charleston range	[illegible] 2100 m		Possibly extinct [illegible]
	[illegible]	[illegible]	Boraginaceae	[illegible] NV	Elko, Eureka and NE Nye Cos., NV	Alkaline calcareous foothill & rocky clay with sagebrush	4400-4600'	June-July	** [illegible]
	[illegible]	[illegible]	Boraginaceae	[illegible] NV	Charleston Mtns, Clark Co., NV & Providence Mtns, San Bern. Co., CA	Dry rocky slopes on limestone, in hills & washes associated with Mtn. mahogany & juniper	4500-6000' [illegible] m		[illegible]
[illegible]	[illegible]	Water [illegible]	[illegible]	[illegible]	Millard [illegible] UT [illegible]	Alluvium, sandy [illegible] desert shrub community	[illegible] m	August	Possibly extinct
	[illegible]	[illegible]	Apiaceae	[illegible] NV, [illegible] UT	Millard [illegible] UT	Restricted to basalt [illegible] soils on exposed slopes; basalt flows are often associated with thermal springs; may be present in adjacent NV		April-early June	Common [illegible] abundant in UT ** [illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 6 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
6[illegible]	[illegible] corrugatus M. E. Jones [illegible] Wats	Corrugate-winged [illegible]pterus	A[illegible]aceae	T [illegible]	Widely distributed from [illegible] NV to SE CA	[illegible] areas		April-May	[illegible]
[illegible]	[illegible] M. E. Jones Mathias	[illegible]	Apiaceae	T [illegible]	Sanpete, Sevier & Juab cos., UT	Arapien Shale Formation, barren foot-hills, gravelly to clay soil; black sage & shadscale community	[illegible] m	March-April	Gypsum exploitation threat [illegible]
[illegible]	[illegible] minimus (Mathias) Mathias	Cedar Breaks [illegible]	Apiaceae	T RE[illegible]UT	Iron & Garfield cos., Cedar Breaks, Bryce Canyon area	Wasatch Formation, mixed conifer woodland, ponderosa community	[illegible] m	Late May-June	Limestone exploitation threat
[illegible]	[illegible] Wats	[illegible] spring parsley	A[illegible]aceae	T PT[illegible]	Mtns of central [illegible] & NE [illegible] (Nye & [illegible] Co[illegible]	Rocky places at high elevations		[illegible] August	[illegible]
[illegible]	[illegible] Barneby var. [illegible]		Apiaceae	Not listed in FR RO[illegible]	Nye, [illegible] & Esmeralda cos.	Sand dunes & sandy soils with *Rumex venosus*, *Oenothera pallida*, *Chrysothamnus viscidiflorus*, *Grayia* sp.	[illegible] m		[illegible]
[illegible]	[illegible] Welsh, Neese		A[illegible]aceae	Not listed in FR PT(NV)	Lander Co., NV; Toiyabe Range	On gravelly limestone slopes with *Draba arida* near alpine zone	730[illegible]-[illegible]900[illegible] [illegible] m	June-July	[illegible]
[illegible]	*Dalea kingii* S. Wats Barneby	King indigo bush	Fabaceae	T RO NV	Churchill & Humboldt cos., NV	Drifting sand in high canyons, sand dunes & interdune spaces with *Ambrosia* sp., *Rumex*, *Oryzopsis* & *Chrysothamnus* spp.	430[illegible] [illegible] m	June-July	Existing ORV threat [illegible]
[illegible]	*Draba arida* [illegible] Hitchc	Desert draba	Brassicaceae	T [illegible](NV)	Nye & Lander Co., Toquima & Toiyabe Mtns	Loamy soil in moist meadows nearing alpine zone with limber pine & aspen	[illegible] 3048-[illegible] m	June-July	[illegible]
[illegible]	*D. asprella* Greene var. *zionensis* [illegible] Hitchc. Welsh & Reveal	Zion whitlow-grass	Brassicaceae	T PT(UT)	Washington Co., UT; Zion NP & BLM land	Decomposed sandstone and talus in mtn brush & pine communities; gravelly soil	6[illegible]-85[illegible] 183[illegible]-2593 m		[illegible]
[illegible]	*D. asterophora* Payson var. *asterophora*	Star draba	Brassicaceae	T PT(NV)	Toiyabe Range in Landers & Nye Co., NV; Eldorado & Alpine cos., CA	Rock crevices & talus, alpine basin meadows with *Pinus flexilis*	[illegible] m	July-August	[illegible]
[illegible]	*D. crassifolia* Graham var. *nevadensis* C. L. Hitchc	Rocky Mountain draba	Brassicaceae	T PT(NV)	SW NV & Mono Co., CA; Endemic to Toiyabe Range, Lander & Nye cos., NV	Moist meadows and disturbed soils with aspen and species of open meadows	90[illegible] [illegible] m	June-July	[illegible]
[illegible]	*D. douglassii* A. Gray	Douglas draba	Brassicaceae	T RO(NV)	Central Washington east OR, south ID, northern NV	Mid to high elevation on exposed slopes reported in association with serpentine soils in sagebrush community with sage and Engelmann spruce	46[illegible]-65[illegible] [illegible] m	June	[illegible]
[illegible]	*D. jaegeri* Munz & Johnst	Jaeger draba	Brassicaceae	T PT NV	Known only from Charleston Mtns, Clark Co., NV	Occurs occasionally in rock crevices, gravelly slopes above timber line with *Pinus aristata*	[illegible] 350 m	Late April-July	[illegible]
[illegible]	[illegible]	Charleston draba	Brassicaceae	T PT(NV)	Known only from Charleston Mtns, Clark Co., NV	Grows on damp soils where snow drifts persist into summer; associated with limber pine and bristlecone pine	[illegible] 345[illegible] m	June-early July	[illegible]
[illegible]	[illegible] Rydb	[illegible] whitlowgrass	Brassicaceae	T PT(UT)	Piute and Garfield cos., UT	Modified tertiary igneous gravel, timberline, ponderosa pine, mountain shrub communities, gravelly soil	[illegible] 229[illegible] 366[illegible] m		[illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 7 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
80	*D. sphaeroides* Rays var. *cusickii* Robbins. Hitchc.		Brassicaceae	T(OR) RC(NV)	SE Oregon & adjacent NV Nye and White Pine Cos.	Boreal zones		June-August	(21, 34
81	*D. stenoloba* Ledeb. var *ramosa* C.L. Hitchc.	Carson Range draba	Brassicaceae	T RT(NV)	Region of Lake Tahoe	Damp, shady slopes	[illegible] 2134-[illegible] m	May-August	[illegible]
82	*D. subalpina* Goodman & Hitchc.	Subalpine whitlow grass	Brassicaceae	T RT(UT)	Iron, Garfield, Kane, & Millard Cos. NPS USFS & BLM land	Pink Limestone Member of the Wasatch Formation, gravel or clay loam; spruce, fir, Douglas fir or bristle cone pine woodlands	[illegible] 2140-[illegible]447 m	May-July	Restricted to limestone (22)
83	*Echinocereus engelmannii* (Parry) Lemaire var *purpureus* L. Benson	Purple hedgehog cactus	Cactaceae	E RE(UT) PE(UT)	Washington Co., UT	Navajo sandstone formation, sandy clay soil, desert shrub community	[illegible] [illegible] m	July	Commercially exploited (22)
84	*Elodea nevadensis*	Nevada water-weed	Hydrocharitaceae	E RE(NV)	Washoe Co., NV	In ponds near Wadsworth		July	Possibly extinct [illegible]
85	*Enceliopsis nudicaulis* (A. Gray) A. Nels. var. *corrugata* Cronq.	Ash Meadows sunray	Asteraceae	T RT(NV)	Nye Co. (Ash Meadows)	Several locations of Ash Meadows, in *Atriplex*	[illegible]	April-May	[illegible]
86	*Ephedra funerea* Cov. and Morton	Death Valley ephedra	Ephedraceae	T(CA) RC(NV)	Endemic to northern Mojave Desert: Death Valley N.M. & SW NV	In bajadas, gentle slopes & hills among & below limestone ranges with *Larrea Atriplex, Ambrosia,* or *Coleogyne*	1000-5[illegible] [illegible]-1524 m	March-May	** [illegible]
87	*Epilobium nevadense* Munz.	Nevada willowherb	Onagraceae	E RT(NV)	Beaver Dam Mtns. Washington Co. UT & Charleston Mtns. Clark Co., NV	Talus slopes, rocky outcrops, ponderosa pine & aspen community in pine duff	7500-9[illegible] 2288-29[illegible] m	July	Perennial, Mineral, exploit[illegible] [illegible]
88	*Erigeron latus* (Nels.& Macbr.) Cronquist		Asteraceae	E(ID) RT(NV)	Owyhee Co., ID, Elko Co., NV (recently located)	On lava sands and rocky outcrops in mtn brush; occurs w *Antennaria arcuata*	525[illegible]-[illegible]400'	July	[illegible]
89	*E. ovinus* Cronq.	Sheep fleabane	Asteraceae	T RC(NV)	Known only from Desert Game Range, Clark & Lincoln Cos., NV	Rocky places in the mountains.			[illegible] (47
90	*E. proselyticus* Nelson	Cliff daisy	Asteraceae	E RE(UT)	Iron Co., UT (USFS land)	Wasatch Formation, talus slopes, loose sandy soil on canyon walls, or calcareous rocks; spruce-fir community	9000' (2745 m)	July	Endemic to type local ty; limestone mining; hwy realignment; timber harvest (22)
91	*E. religiosus* Cronq.	Clear Creek fleabane	Asteraceae	E RE(UT)	Kane & Washington Co. BLM, state & NPS land	Quaternary sand dunes, interdune valleys & sand terraces	5000-6000' (1525-1830 m)	June-August	Main habitat Coral Pink Dunes, ORV use (22)
92	*E. uncialis* Blake var. *conjugans* (Blake) Cronq.	Inch-high fleabane	Asteraceae	T RC(NV)	Toiyabe N.F., Clark & Nye Cos., NV	Crevices of limestone rocks with *Abies concolor, Pinus monophylla, P. ponderosa*	[illegible]7800' (2377 m)	June	(27,51)
93	*Eriogonum ammophilum* Reveal	Sand-loving buckwheat	Polygonaceae	E RE(UT) High priority for fed. listing	Millard Co., UT	Quaternary alluvium, sandy soil, desert shrub community	5230' (1595 m)	June-July	**, (22)
94	*E. anemophilum* Greene	Wind-loving buckwheat	Polygonaceae	E RC(NV)	Humboldt Co., NV & CA	Dry granitic and volcanic soils, Yellow Pine F., Red Pine F., Alpine fell-fields.	9000-12,000' (2743-3660 m)	July-August	(22)

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 8 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
95	*E. [illegible]* Reveal	[illegible] buckwheat	Polygonaceae	E RE(NV) SE(NV) High priority for fed. listing	[illegible] Co., NV	On rusty mineralized sand or sandy washes below Sulphur Hot Springs, Ruby Valley	[illegible] (1844 m)	[illegible]	** [illegible]
95a	*E. beatleyae* Reveal	Beatley buckwheat	Polygonaceae	Not listed	Nye, [illegible], Lander, & Mineral [illegible] NV, Mono [illegible] CA	Dry volcanic outcrops, [illegible] red clay in pinyon-juniper and blacksage. Found primarily on mine tailings around abandoned mines	[illegible] (1451-[illegible] m)	May-August	** [illegible]
96	*E. [illegible]* Reveal	Stewart [illegible] Pahrump Valley buckwheat	Polygonaceae	T RT(NV)	S. Nye Co. (only from W. Pahrump [illegible] & S. Stewart Vly & Inyo Co., CA	In lower portion of valley floodplain	2500' (762 m)	June	[illegible]
97	*E. [illegible]* Reveal	Elegant buckwheat	Polygonaceae	T RC(NV)	Nye Co. (found in NBGR & NTS)	Restricted to sandy soils of volcanic origin with *Atriplex canescens* & *Artemisia* or pinyon-juniper also on recent road-cuts in this soil type with *Salsola* & other *Eriogonum* sp.	4500-6700' (1372-2050 m)	May-Sept.	Regional endemic with limited range ** [4, 5]
98	*E. [illegible]umbosum* Benth. var. *matthewsiae* Reveal	Matthews buckwheat	Polygonaceae	RE(UT)	Washington Co., UT near Zion Nat'l Pk on private land	Chinle Formation, purplish siltstone & sandy loam soil	3800-4000' (1159-1220 m)	August-September	[20]
99	*E. [illegible]* Kearney	[illegible]arrow buckwheat	Polygonaceae	T RC(NV)	White Pine Co., NV & Coconino Co., AZ	On sandy soil with Cowania & sagebrush in Pinyon-Juniper woodlands	6000-6500' (1830-1981 m)	August-Sept.	** [illegible]
[illegible]	*E. eremi[illegible]* Reveal	Limestone buckwheat	Polygonaceae	T RE(NV) RT(UT)	Millard Co., UT	Sevy dolomite gravel, clay & limestone, rolling hills & flats; semi-desert shrub community	5400-6200' (1647-1891 m)		An obligate calciphile ** [20]
101	*E. holmgrenii* Reveal	Holmgren buckwheat	Polygonaceae	T RT(NV)	Snake Range, White Pine Co., NV within Humboldt N.F.	In quartzite rock crevices and limestone soils	10,000-12,000'	July-August	[22, 33]
102	*E. [illegible]* Benth. var. *[illegible]* Reveal	Sandstone buckwheat	Polygonaceae	T RT(UT)	Kane & Washington Cos., UT (N.P.)	Navajo Sandstone Formation on sandstone ledges & adjacent reddish sand blow-out areas	5200' (1586 m)	July-August	ORV use
103	*E. [illegible]* Wats.	[illegible] buckwheat	Polygonaceae	E RT(NV) SE(NV)	Truckee R. Cyn. Washoe Co., NV	Dry gypseous gravelly clay	4200' (1280 m)	June	[27]
104	*E. [illegible]* T&G var. *[illegible]* (Greene) Jones	Andesite buckwheat	Polygonaceae	T RT(NV)	Washoe, Storey Cos., NV			June	
105	*E. [illegible]atum* Reveal	Terrace buckwheat	Polygonaceae	Not listed in FR RT(UT)	Millard Co., UT	Quaternary lacustrine deposits, saline marly playa remnant	5000-5800' (1525-1769 m)	August-Sept.	Roadways gravel pits** [20]
105a	*E. nummulare*	No common name	Polygonaceae	Not listed in FR	S. Tooele, Juab and Millard Cos., UT	With shadscale and juniper	5000-6000'	July-Sept.	From 2 disjunct locations** [33]
106	*E. [illegible]* M.E. Jones	[illegible] buckwheat	Polygonaceae	T RT(UT)	Piute & Sevier Cos., UT	Clay hills & slopes, cool desert shrub & pinyon-juniper community along the Sevier River	4300-6500' (1312-1983 m)	August-Sept.	[20]
107	*E. ovalifolium* Nutt. var. *[illegible]* Reveal	Cushion buckwheat	Polygonaceae	T RC(NV)	Nye Co. Toquima & Toiyabe Mtns.	Alpine; sandy & gravelly areas	10,900-11,800' (3322-3600 m)	June-July	[11]
108	*E.* [illegible]		Polygonaceae	Not on FR list RE(NV)	Washoe Co. (Steamboat Springs)	No information available		July-Sept.	Geothermal development threat [32]
109	*E. panguicense* (M.E. Jones) Reveal var. *alpestre* (S. Stokes) Reveal	Panguitch buckwheat	Polygonaceae	T RT(UT)	Iron Co., UT	Volcanic gravel & limestone, whitish clay outcrops of rim rocks; spruce fir meadow community	9500-11,000' (2898-3355 m)		Endemic to upper rim of Cedar Breaks; ORV [20]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 9 of 16).

NO	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
[illegible]	E. rubricaule Tidestrom	Red-stem Buckwheat	Polygonaceae	RT NV	[illegible], Lander, Churchill, Mineral & Nye Cos., NV	A variety of soil conditions from lava outcrops to heavy clay soils & dry desert foothill slopes, often with shadscale & other spp of Eriogonum	[illegible]		**
[illegible]	E. thompsonae S. Wats. var. albiflorum Reveal	Thompson Buckwheat	Polygonaceae	T RT UT	Washington Co., UT & Mohave Co., AZ	Moenkopi Formation, red gypsiferous clay silt to sandy soil, desert shrub community	[illegible]		
	E. [illegible] Wats. var. thompsonae	Thompson Buckwheat	Polygonaceae	T RT UT	Kane & Washington Cos., UT, Mohave Co., AZ	Carmel & Chinle formations, sandstone talus, clay loam, desert shrub community	[illegible]		
[illegible]	E. [illegible] J.T. Howell	[illegible] Buckwheat	Polygonaceae	RE NV SE NV	Known only from near Riverside, Clark Co., NV	In sandy soil on north bank of Virgin River	[illegible]	April-August	[illegible]
[illegible]	E. zionis J.T. Howell var. zionis	Zion Buckwheat	Polygonaceae	RT UT	Kane & Washington Cos.	Navajo sandstone formation, sandy alluvium; cool desert & montane shrub community	[illegible] m		
[illegible]	Ferocactus acanthodes Lemaire (Britt. & Rose)	Miner's Compass	Cactaceae	RC NV	Deserts of SE CA, south NV, and AZ	Gravelly rocky desert slopes and hillsides		April-June	**, [illegible]
[illegible]	Forsellesia pungens (Bdg.) Heller	Low greasebush	Celastraceae	Not listed RT NV	Endemic to Mohave Desert of NV & CA. Typical variety is found in the Sheep Mts., Clark Co., NV	Rocky slopes	4000-5000 ft 1219-1524 m	May-June	[illegible]
[illegible]	Frasera [illegible] (Barneby) M. Post	Sunnyside Green Gentian	Gentianaceae	RE NV SD UT SE NV	Nye Co., Sunnyside. Known only from type locality	Gypsum flats along the lower waters of the White River in sandy alluvial soils, sometimes arising from mounds of Lepidium nanum	[illegible] 1524 m		[illegible] **
[illegible]	F. pahutensis Reveal	Pahute Green Gentian	Gentianaceae	RT NV	Nye Co., south Toquima Range & Pahute Mesa	Loose volcanic soil in pinyon-juniper & sagebrush, Purshia & Chrysothamnus sp.	[illegible] 2200-2275 m	May-June	** [illegible]
[illegible]	Fraxinus cuspidata var. macropetala	Fragrant Ash	Oleaceae	T RT NV	N. AZ & S. NV, Clark Co.	About small swamps 4 mi N of Glendale			Known only from [illegible]
[illegible]	Galium hilendiae Dempster & Ehrendorfer var. kingstonense Dempster (Dempster & Ehrendorfer)	Kingston Bedstraw	Rubiaceae	RE NV	Nye Co., NTS, and San Bernardino Co., CA	Steep talus slopes derived from cliffs of densely welded tuff of the Indian Trail Formation with pinyon pine, big sage, & Gambel oak	[illegible]	June	[illegible]
[illegible]	Geranium toquimense Holmgren & Holmgren	Toquima Geranium	Geraniaceae	RC NV	Nye Co., Pine Creek in Toquima Range	In boulders on north-facing slopes, endemic to talus slopes with Ribes montigenum, Aquilegia [illegible], Penstemon [illegible], alpine & subalpine vegetation	[illegible]	August	[illegible]
[illegible]	Gilia nyensis Reveal	Nye Gilia	Polemoniaceae	RC NV	Endemic to central & southern Nye Co., NV (mostly in NTS)	Restricted to areas of deep sand derived from light volcanic tuff in open spaces among shrubs, pinyon-juniper, big sage, black sage & four wing saltbush on flats or moderate slopes; sometimes found along roadsides	[illegible]	May & June [illegible]	[illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 10 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
[illegible]	[illegible] ripleyi Barneby	Ripley [illegible]	Polemoniaceae	T RC NV	Endemic in Panamint Range, Inyo Co., CA to mountains of SW Nye Co.	In crevices of steep [illegible]	[illegible]	May-June-July	Herbaceous perennial. ** [4]
[illegible]	Grindelia fraxino-pratensis Reveal & Beatley	Ash Meadows gumweed	Asteraceae	T	Nye Co. Ash Meadows	[illegible] alkaline soils of salt grass meadows	[illegible] 664-[illegible]m)	June-Oct	Perennial or long-lived bi-ennial [27]
[illegible]	Hackelia [illegible]	Owyhee River stickseed	Boraginaceae	T RE NV	Humboldt [illegible] the Sheldon NWR			June	
[illegible]	Haplopappus alpinus Anderson	Goldenweed alpine	Asteraceae	Not listed RT NV	Toiyabe Range [illegible] Lander & Nye Cos.	Steep granite slopes with scattered Pinus flexilis [illegible] timber line	9000-[illegible]400' ([illegible]743-3292m)	July	[27]
[illegible]	H. brickellioides Blake	Brickell goldenweed	Asteraceae	T RC NV	Regional endemic on limestone mtns of Death V. & SW NV Nye Co.	Steep north or east [illegible] slopes, rock outcrops & cliff faces [illegible] crevices of mtn ranges of limestone or dolomite co-domi-nant with Ferocactus megalocephala var. intricata, Gilia ripleyi & Agave utahensis var. eboris-pina. All rare species associated shrubs include shadscale, Brickellia atractyloides, Ephedra, Lepidium fremontii & Gutierrezia micro-cephala	[illegible] [illegible]982 m)	April-Oct	** [4]
[illegible]	H. [illegible]		Asteraceae	T RC NV	S. Washoe Co. NV to Eldorado Co. CA.	Granitic soils near tree line Subalpine Forest	8600-9600' (2621-2926 m)	July-August	[22]
[illegible]	H. watsonii A. Gray	Watson goldenweed	Asteraceae	Not listed RC NV	Nye Co. NTS	Restricted to crevices in volcanic cliffs in Artemisia-Pinyon-Juniper	6400-6600' (1951-2012 m)	Sept.-Oct	[4]
[illegible]	Helianthus deserticolus Heiser	Desert sunflower	Asteraceae	Not listed RE UT	Washington Co., UT, Mohave Co., AZ & Clark Co., NV (BLM land)	Dry sandy soil, open areas in desert shrub community	2130-4500' (641-1372 m)	June-Sept.	Annual, urban sprawl threat [20]
[illegible]	Heuchera durani		Saxifragaceae	Not listed RC NV	Nye Co., NV Toquima Mtns	Rock crevices on morainal slope	9600-11,300' (2926-[illegible]m)		[27]
[illegible]	Hulsea vestita A. Gray var. inyoensis (Keck) Wilken	Inyo hulsea	Asteraceae	T RC(NV)	Nye & Esmeralda Co., NV, NTS & Inyo Co., CA	On undisturbed sites on steep slopes of coarse volcanic tuff gravel, plants utilize instable habitats character-ized by erosion & landslides with pinyon-juniper, big sage or four wing salt bush	4600-7200' (1402-2195 m)	May-July or Sept-Oct in some areas	** [4]
[illegible]	Hymenopappus filifolius Hook var. tomentosus Rydb	Cobweb hymenopappus	Asteraceae	T RT(UT)	Washington & Kane Cos.	Sandy soils over a broad range		June-July	ORV use threat [20]
[illegible]	Ivesia crypto-caulis (Clokey) Keck	Charleston ivesia	Rosaceae	E RT NV	Known only from a small area on Charles-ton Peak, Toiyabe N.F Clark Co., NV	Occurs at or above timberline in lime-stone, rocky or gravelly slopes	11,[illegible]' (3500m)	July-August	[2]
[illegible]	I. eremica (Cov.) Rydb.	Ash Meadows ivesia		E RE(NV)	Nye Co. Ash Meadows endemic	On light colored clay uplands with other endemics near spring areas	2200-2300' (670-[illegible]m)	Sept.-Oct.	Perennial [29]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 11 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
135	*Lathyrus hitchcockianus* Barneby & Reveal	Mojave sweet pea	Fabaceae	S RE(NV) SE(NV)	[illegible] locations in Nye NV, NTS, & [illegible] Inyo [illegible] CA	In protected situations, often under shrubs, through which their long green stems with tendrils climb, in pinyon-juniper associations, washes & canyon bottoms in gravelly to sandy loam	[illegible] 1[illegible] m	April-May	[illegible] **
136	*Lepidium nanum* S. Wats.	Dwarf pepper-grass	Brassicaceae	T RC(NV)	Nye & Elko, White Pine, Eureka Cos., NV	Well drained soils, in sand or gravel with black sage in calcareous mtns.	[illegible] 1[illegible]5 m	June-[illegible]	[illegible] **
136a	L. [illegible]steri Welsh	[illegible]ster pepperdrass	Brassicaceae	Not Listed F.R.	Information not available			[illegible]	**
137	*Lesquerella hitchcockii* Munz	[illegible] bladderpod	Brassicaceae	T RC(NV)	White Pine (Schell Creek Range), Nye (Grant & Quinn Cyn Range), Clark Co. (Charleston Mtns.)	Limestone outcrops & gravelly soils with scattered bristlecone pine	[illegible]	June-[illegible]	[illegible]
138	*Lewisia maguirei* Holmgren	Maguire Lewisia	Portulacaceae	T RE(NV) RD(UT)	Nye Co. Endemic to Cherry Creek Summit in Quinn Canyon Range	Loose eroded soil derived from limestone in pinyon-juniper & sagebrush	[illegible]		** [illegible]
139	*Linanthus arenicola* (Jones) Jeps. & Bail.	Sand flax flower	Polemoniaceae	T RC(NV)	Throughout Mojave Desert region; NE Nye Co., Clark, Esmeralda Cos., NV & Inyo Co., CA	In gypsum-rich sandy soils in flat areas in Joshua tree woodland vegetation or *Larrea-Ambrosia* vegetation	[illegible] m	March-May	Annual [illegible] **
140	*Lomatium ravenii* Math. & Const.		Apiaceae	E(CA) RC(NV)	Lander & Nye Cos. (Toiyabe Range) and Millard Co., UT (Confusion Range); also OR, ID & CA	On rocky talus slopes in pinyon-juniper & sagebrush or mtn mahogany communities	[illegible] 1[illegible]- 2231 m	May-[illegible]	Widespread and abundant throughout its range** [illegible]
141	*Lupinus holmgrenanus* C.P. Smith	Holmgren lupine	Fabaceae	T RC(NV)	Esmeralda & Nye Co., NV & Inyo Co., CA; mostly in Sarcobatus Flat drainage S Nye Co., NV	Gravelly soil in pinyon & sagebrush; abundant in sandy washes near [illegible] Peak & Grapevine Mtns.	4850-[illegible] 1478-[illegible] m	May	[illegible] **
142	L. jonesii Rydb.	Jones lupine	Fabaceae	RT(UT)	Washington Co.	Alluvium, sandy or limestone soil, pinyon-juniper & mtn brush communities	5800-[illegible] 17[illegible]- [illegible] m		[illegible]
143	L. *malacophyllus* Greene	[illegible]leaf lupine	Fabaceae	T RC(NV)	W. NV-Washoe Co., Douglas Co. and in CA.	Dry hillsides in pinyon-juniper.	4750-[illegible]	Late May-early [illegible]	[illegible]
144	L. *montigenus* Heller	Mountain lupine	Fabaceae	T RC(NV)	Washoe Co., Desert Game Range, Clark Co. and eastern CA	Loose gravel on high ridges, dry fell fields, barren alpine areas, and granitic outcrops	[illegible] [illegible]49 m	July-August	[illegible]
145	*Machaeranthera grindelioides* var. *depressa*	Dwarf gum-weed machaeranthera	Asteraceae	T RC(NV) RD(UT)	Western Millard, Tooele & Beaver Cos., UT	On knolls and ridges		May-June	Widespread in [illegible]
146	M. *leucanthemifolia* (Greene) Greene	White-leaf machaeranthera	Asteraceae	E RC(NV)	Washington to Montana & Idaho, south to Colorado & NV	A weedy species of disturbed sites with shadscale, sagebrush, pinyon-juniper, mtn mahogany & ponderosa pine		June-Sept	Taxonomic [illegible] considered by some to be a minor variant within wide-spread M. canescens [illegible]**
147	*Mentzelia leucophylla* Bdg.	Ash Meadows blazing star	Loasaceae	E RE(NV) SE(NV) High priority for F.R. listing	Endemic to Ash Meadows SW Nye Co., NV	Restricted to flats & knolls of calcareous alkaline soil with shadscale & *Encelia* [illegible]psis *nudicaulis* var. *corrugata*	[illegible]	May-Sept	[illegible]
148	*Mertensia toiyabensis* MacBride	Toiyabe Mtn bluebell	Boraginaceae	E RC(NV)	Toiyabe Range, Lander & Nye Cos., NV	Near aspen stands & in drainages with aspen, sagebrush, snowberry, rose-cherry & Great Basin wildrye	[illegible] 21[illegible]- [illegible] m	June	[illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 12 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DESCRIPTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
149	Mimulus washoensis Edwin	Washoe monkey flower	Scrophulariaceae	RT NV	Washoe Co., Pyramid Lake area	Granite fans and mountain slopes	4000-4500'	May	[3]
150	Mirabilis pudica Barneby	Bashful four o'clock	Nyctaginaceae	T RC NV	Endemic to SE Nye, SW Lincoln, NW Clark Cos., NV (Pahranagat, Groom, Penoyer & several other valleys & NTS)	Confined to basin floors & alkaline areas near lake beds from calcareous gravel foothills to sandy vlys & playas in saline soils with chenopodiaceous shrubs; prompt & weedy colonizer in disturbed areas (roadsides or denuded areas) where highest density populations are found	3000-5500' (915 - 1679 m)	May-June	Geophytic perennial shrub [4]**
151	Opuntia pulchella Engelm.	Sand cholla	Cactaceae	Not listed RC NV; RC UT in FR	Nevada from east central, Washoe Co., Lyon Co., Esmeralda to Lander & S. White Pine Cos., western UT, NW AZ, Mohave Co.	Sand of dunes, dry lake borders, river bottoms, washes, valleys, & sagebrush desert	4000-7000' (1219-2134 m)	May-July	Important food source [12,8]**
152	O. whipplei Engelm. & Bige. var. multigeniculata Clokey L. Benson	Many-jointed whipple cholla	Cactaceae	T RT (NV) RD (UT)	Mojave Desert from CA to AZ, Charleston Mtns., Clark Co., NV	Rocky or sandy ridges.	4700'	June-August	[34]
153	Oryctes nevadensis Wats.	Nevada oryctes	Solanaceae	RC (NV)	Western NV, CA & ID	Sandy places near Alkali Sink.	4000-5000' (1220-1524 m)	May	[22]**
154	Oxytheca watsonii T&G	Watson's oxytheca	Polygonaceae	RT NV	Lake Mead NRA, Clark Co., Nye Co., Mineral Co.		5500' (1680 m)	July	[27]**
155	Pediocactus sileri (Engelm.) L. Benson	Siler pincushion cactus	Cactaceae	E RE (UT) FE	Washington Co., UT; Mohave Co., AZ near St. George UT	Moenkopi Formation, sandy, gypsiferous, calciferous soils high in soluble salts; desert shrub, Atriplex-Tetradymia communities	3000-5000' (915-1525 m)	June	[22]
156	Penstemon arenarius Greene	Dune penstemon	Scrophulariaceae	T RT (NV)	Nye & Esmeralda; endemic to Tonopah area	Sandy soils with four-wing salt bush & Tetradymia glabrata	4000' (1220 m)	May-June	[5]**
157	P. bicolor (Brandegee) Clokey & Keck var. bicolor	Bicolor penstemon	Scrophulariaceae	T RT (NV)	Known only from Clark Co. (Charleston Mtns) and adjacent AZ	Gravelly soils in washes along road shoulder in Larrea Ambrosia & Joshua tree	2900-4700' (884-1433 m)	May	[26,27]
158	P. b. (Brandegee) Clokey & Keck var. roseus Clokey & Keck	Rosy bicolored penstemon	Scrophulariaceae	T RT (NV)	S. Charleston Mtns., Clark Co., NV & W Mohave Co., AZ	Gravelly washes with Larrea & Yucca		May	[27]
159	P. concinnus Keck	Tunnel Springs beardtongue	Scrophulariaceae	E RT (UT) High priority for federal listing**	Beaver & Millard Cos., UT	Sevy Dolomite Formation, gravelly soil, pinyon-juniper woodland	5500-7500' (1678-2288)	May-June	Occurs with several other endemics on Sevy Dolomite Form.** [22]
160	P. franciscii-pennellii Crosswhite	Pennell penstemon	Scrophulariaceae	RT (NV)	White Pine Co., NV. Restricted to Wheeler Peak area	On open stony spruce slopes, talus slopes below cliffs.	3500-11,500'	August	[33]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada-Utah study area (Pg. 13 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
161	P. fruticiformis [illegible] var. amargosae Keck	Amargosa penstemon	Scrophulariaceae	RT NV	[illegible]	[illegible] gravelly washes [illegible]	[illegible]	Late [illegible]	[illegible]
162	P. humilis Nutt var. obtusifolius Pennell	Springdale beardtongue	Scrophulariaceae	RT UT	[illegible]	Navajo [illegible] formation [illegible]	[illegible]		
163	P. keckii Clokey		Scrophulariaceae	RC NV	[illegible] Mtns. [illegible] White Pine	[illegible]	[illegible]	June- [illegible]	[illegible]
164	P. moriahensis Holmgren	Mt. Moriah penstemon	Scrophulariaceae		White Pine [illegible] Snake Range [illegible]	Sagebrush [illegible] mahogany woodlands and ponderosa pine	[illegible]		4
165	P. nanus Keck	Dwarf beardtongue	Scrophulariaceae	E RT/NV RD/UT	Beaver, Millard [illegible] UT. In Desert Range Experimental Station and vicinity.	Sevy dolomite formation [illegible] gravel, dry exposure in sagebrush, juniper, & mixed desert shrub community on alluvial fans, talus slopes & rocky outcrops in arid sites where other plants are few	[illegible]	Late May-early June	** [illegible] Was confused with P. [illegible] until recently.
166	P. pahutensis N. Holmgren	Pahute penstemon	Scrophulariaceae	E RT NV	Southcentral Nye Co. [illegible] around NTS & Shenewall Mtn.	Open areas in loose soil or rocky areas or growing from crevices; in pinyon juniper or big sagebrush; not restricted to one specific habitat; common on disturbed areas.	[illegible] 2242-2290 m.	June-mid-July	[illegible]
167	P. procerus Keck var. modestus Greene	Ruby Mtns. beardtongue	Scrophulariaceae	T RT NV	E. Ruby Mtns., Elko Co., NV	In alpine dry meadows usually on rocky soils with mtn. mahogany and *Juniperus scopulorum*.	8600-9000'	July-August	[illegible]
168	P. pudicus Reveal & Beatley	Bashful penstemon	Scrophulariaceae	T RT NV	Nye Co. known only from Kawich Peak areas of Kawich Range	Washes & barren slopes in pinyon-juniper with big sage & mtn mahogany	7600-9000' 2317-2743 m	June	25, [illegible]
169	P. rubicundus Keck		Scrophulariaceae	E RC NV	Mineral Co. [illegible] Walker Lake	Dry [illegible]		June	[illegible]
170	P. thompsoniae (Gray) Rydb. var. jaegeri Keck	Jaeger penstemon	Scrophulariaceae	T RT NV	Clark Co. NV	Flats and gentle slopes	2600-2900' [illegible]-884 m	May-June	[illegible]
171	P. thurberi Torr. var. anestius Reveal & Beatley	Buried Hills penstemon	Scrophulariaceae	E RE NV SE NV	Known only from type locality in NW Clark Co. near boundary of NTS and Desert Game Range, Nye Co.	The type population covers several hectares in deep volcanic sands in the upper bajada below the SW end of the Buried Hills association with *Larrea-Ambrosia-Krameria* & *Larrea-Dalea fremontii*.	3800-4100' 1159-1250 m	June	
172	P. tidestromii Pennell	Tidestrom beardtongue	Scrophulariaceae	RT UT	Sanpete & east Juab Co. UT	Desert shrub, sagebrush, snowberry & juniper communities on a variety of substrates.	[illegible]-4200' [illegible]	May-early June	Has been impacted by grazing (20)

135-[illegible]

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 14 of 16).

No.	Species	Common Name	Family	Status	Known Distribution	Habitat	Elevation	Flowering Time	Remarks and References
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] shale, sand [illegible] formations, clay [illegible] shale hills [illegible] and greasewood communities	[illegible] (... m)	Late April–June	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Not listed	[illegible]	Information not available			Recently discovered [illegible]
[illegible]	[illegible] Branded [illegible]	[illegible]	[illegible]aceae	[illegible]	[illegible]	[illegible] restricted to sedimentary carbonate substrates, limestone or dolomite in most of the mtn ranges of southern NV in habitats ranging from lower slopes & washes to steep cliffs & ridge tops at higher elevations with other rare [illegible] Other associations are Ephedra, Gutierrezia, [illegible]	[illegible] (... m)	June–August	** (4)
[illegible]	Peteria thompsonae Wats.	Thompson peteria	Fabaceae	T UT, RC NV & AZ, RC UT	Localized populations in [illegible] Kane, San Juan, & Washington Cos., [illegible] north AZ, [illegible] populations on NTS in southern NV	On dry rocky cliffs [illegible] as [illegible] AZ [illegible] NTS.	[illegible] (... –1768 m)	May–June	Herbaceous perennial ** (4)
[illegible]	Phacelia anelsonii [illegible] Macbride	A. Nelson [illegible] Macbride [illegible]	Hydrophyllaceae	T	RT NV, RT UT	Washington Co., UT; Lincoln Co., NV; Inyo & San Bern. Cos., CA	Shady places at the base of sandstone or limestone cliffs or among rocks or sandy to gravelly washes; warm desert shrub & Joshua tree community	2500–5000' (763–1373 m)	April–May	Annual. ORV Allen-Warner Meadow [illegible] wash popl. may be affected by grazing [illegible] **
[illegible]	P. argillacea Atwood	Clay phacelia	Hydrophyllaceae	E	PE UT, PE UT	Spanish Fork Canyon, Utah Co., UT	Green R. shale formation, detritus slopes, rocky clay soil, grassland & scattered mtn. shrub community.	6600' (2011 m)	June	Only one population of 4 individuals left. (20, 33)
[illegible]	P. beatleyae Reveal & Constance	Beatley phacelia	Hydrophyllaceae	E	RT NV	Nye & Lincoln Cos., NV; NTS	Light-brown volcanic tuff, on loose talus & along washes with Atriplex hymenelytra	4000–5800' (1220–[illegible] m)	May	(4)
[illegible]	P. [illegible] Gray	[illegible] scorpionplant	Hydrophyllaceae	T	RT UT	Kane & Washington Cos., UT; Mohave & Navajo Cos., AZ	Chinle Formation, alluvium, bare clay soil, salt desert shrub community	2000–4500' (612–1373 m)	May	Annual [illegible]
[illegible]	P. glaberrima (Torr.) Howell	Smooth phacelia	Hydrophyllaceae	T	RT NV	Lander Co., NV	Alkaline soils on talus slopes in Reese River Valley	4000–5000' (1220–1524 m)	May–June	Heavily grazed** (4)
[illegible]	P. inconspicua Greene	Inconspicuous phacelia	Hydrophyllaceae	E	RE NV	W. Humboldt Range, Pershing Co., NV; also Butte Co., ID	Steep slopes with tall sagebrush	5600–6800' (1707–2073 m)	June	Annual [illegible]
[illegible]	P. mustelina Coville	Weasel scorpionweed	Hydrophyllaceae	T	RC NV	Widely but thinly distributed throughout Death Valley region & SW NV	On volcanic crevices of steep cliffs or on limestone substrates in rocky places with Coleogyne, Artemisia-pinyon-juniper to Creosote bush scrub	3000–6500' (915–1982 m)	March–June or June–Sept	Annual (25,4) ** on NTS, TTR
.42	P. nevadensis J. T. Howell	Nevada phacelia	Hydrophyllaceae		RE(NV)	E. Humboldt Mts., Elko Co., NV	Under sagebrush and juniper.	6500' (1981 m)	June	Not seen since 186[illegible] (33,34,27)
.83	P. parishii Gray	Parish phacelia	Hydrophyllaceae	Not listed	RC NV	Nye Co. (NTS), White Pine, Clark, NV; San Bern. Co., CA	Light-colored calcareous sandstone or siltstone knolls of sparse shrub vegetation mainly shadscale & Lycium pallidum	3340' (1018 m)	April–June	ORV problem; NTS has only surviving population ** (4)

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (Pg. 15 of 16).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS[1]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[2]
[illegible]	[illegible]	Red Canyon phlox or Musky phlox	Polemoniaceae	T RT NV RT UT	Garfield, Iron & Washington Cos., UT NV?	Pink Limestone Member of the Wasatch Formation, heavy clay soil, gravelly, scattered yellow-pine forest community.	[illegible]	May-June	An obligate calciphile [illegible]
[illegible]	[illegible]		Rafflesiaceae	RC NV	SE CA, S. NV, SW AZ	Minute stem parasite on Dalea especially on D. emoryi, creosote bush scrub.	[illegible]	March-April	** [illegible]
[illegible]	[illegible]	Beaked spiny milkwort	Polygalaceae	RC(NV)	Nye Co., NV and east Inyo Co., CA.	Alkaline calcareous hills, shadscale scrub.	[illegible]	April-May	** [illegible]
[illegible]	[illegible]	Lamoille Cyn primrose	Primulaceae	E RE NV SE NV	Elko Co., NV; head of Lamoille Cyn in Ruby Mtns.	North-facing slopes in soils of granitic origin in high mtn meadows with Selaginella mats in grass sod; associated with white bark pine	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] nevadensis [illegible]	Nevada primrose	Primulaceae	E RT(NV)	S. Nye Co. & White Pine Co. Grant, Snake ranges & Troy Park	Limestone outcrops with Pinus longaeva, Ribes montigenum Eriogonum holmgrenii	[illegible]		[illegible]
[illegible]	[illegible]	Tahoe yellowcress	Brassicaceae	T RE(NV)	Around Lake Tahoe	Moist places, Yellow Pine Forest	[illegible] 1440 m	June-[illegible]	[illegible]
[illegible]	[illegible] funerea M.E. Jones	Death Valley sage	Lamiaceae	T RC(NV)	S. Nye Co., NV Pahrump & Stewart Vly & Death Vly. region, Inyo Co., CA	Common in shallow upland washes in limestone mountains	2600-3500' (793-1070 m)		[illegible]
[illegible]	[illegible]	Mojave fish-hook cactus	Cactaceae	Not listed RT(NV)	Mojave Desert from Kern Co. to SW NV & south to Mojave River; widely but thinly distributed	On gravelly slopes & near flatrock areas of igneous origin in Artemisia-pinyon-juniper & Atriplex-Ceratoides or creosote bush scrub; overlapping with populations of another threatened cactus Coryphantha vivipara var. rosea	[illegible] (-1421 m)	April-May or June	Threatened by collectors; it is conspicuous** (4,25)
[illegible]	[illegible] pubispinus [illegible]	Great Basin fishhook cactus	Cactaceae	T RT(NV) RE UT	Box Elder, Beaver, Juab, Millard, Sevier & Tooele Cos., UT & White Pine Co., NV	Ancient shoreline & islands of Pleistocene lake, rocky soil of hillsides	5000-6000' (1500-1800 m)	April-June	Exploited by collectors** [illegible]
[illegible]	[illegible]	Utah spike-moss	Selaginellaceae	RT(NV)	One collection from Washington Co., UT; one from east Charleston Mtns., Clark Co., NV	On sandstone ledge near Pine Creek in NV	4700' (1433 m)		[illegible]
[illegible]	Silene clokeyi [illegible]	Clokey silene	Caryophyllaceae	T RT(NV)	Known only from Charleston Mtns., Clark Co., NV	Among rocks at timberline growing under Ribes montigenum	[illegible] (3400 m)	July	[illegible]
[illegible]	[illegible] petersonii [illegible] minor [illegible]	Red Canyon catchfly	Caryophyllaceae	R PT UT	Garfield & Iron Cos., UT; Zion National Pk	Pink Limestone Member of Wasatch Formation on bare gravelly clay & eroding slopes mixed ponderosa pine, fir & western bristlecone pine communities	7000-10,400' (2135-3172 m)	July-August	Threatened by ORV use

Table 3.2.2.8-1. Rare and protected plant species in the Nevada/Utah study area (pg. 16 of 16).

No.[a]	SPECIES	COMMON NAME	FAMILY	STATUS[b]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[c]
[illegible]	S. [illegible] Robinson var. [illegible] beta [illegible] & Mag.	[illegible] silene	Caryophyllaceae	T RT(NV)	Nye [illegible]	Ranges from rocky sagebrush flats & stony basalt slopes [illegible] deep loam with pinyon-juniper & sage-brush	[illegible] (1524-[illegible] m)	May-[illegible]	[illegible]**
[illegible]	Smelowskia holmgrenii Rollins	Holmgren smelowskia	Brassicaceae	E RC(NV)	Nye Co., Toiyabe National Forest, Toquima Range	Crevices of rocks and associated species in alpine tundra	[illegible] (3048-3475 m)	July-August	[illegible]
[illegible]	Sphaeralcea caespitosa M.E. Jones	Jones' tufted globe mallow	Malvaceae	RT(NV) RT(UT)	Beaver & Millard Cos., UT & Nye Co., NV Toiyabe Mtns	[illegible] dolomite, rocky calcareous soil, mixed shrub, pinyon-juniper, and grass community	[illegible] (1525-1981 m)		Restricted to limestone** [20]
[illegible]	Sphaeromeria compacta (Hall) Holmgren	Charleston tansy	Asteraceae	E RT(NV)	Clark Co., NV, Charleston Mths.	Timberline	10,000-11,000'		[34]
[illegible]	S. ruthiae Holmgren, Schultze and Lowrey	Zion tansy	Asteraceae	RT(UT)	Washington Co., NPS Zion National Park	Navajo Sandstone Formation in crevices of canyon walls in Zion[illegible]	4800' (1464 m)	August-September	[20]
[illegible]	Streptanthus oliganthus Roll.	Fewflower twistflower	Brassicaceae	T RT(NV)	NV, Mono Co., CA	Rocky slopes, Red Fir Forest.	8000-8200'	June-July	[22]
[illegible]	Synthyris ranunculina Pennell	Charleston kittentails	Scrophulariaceae	E RE(NV)	Endemic to Charleston Mtns., Clark Co., NV	Limestone cliffs.	(2880-3300 m)	June-August	[illegible]
124	Thelypodium laxiflorum Al-Shehbaz		Brassicaceae	RC(NV)	Lincoln and Nye Cos., NV and UT	Sandy soil.		May-September	** [32, 34]
125	T. sagittatum (Nutt.) Endl. var. ovalifolium Rydb. Welsh & Reveal	Oval-leaf thelypody	Brassicaceae	T RT(NV) RT(UT)	Garfield & Iron Cos., UT; White Pine Co., NV	Clay soils		May-June	Biennial or short-lived perennial. Urban development is a threat [20]**
126	Townsendia jonesii (Beaman) Reveal var. tumulosa Reveal	Charleston ground-daisy	Asteraceae	T RT(NV)	Endemic to Charleston Mtns., Clark Co., NV.	With Ponderosa pine.	10,000'	April-June	[33]
127	Trifolium andersonii Gray var. beatleyae Gillett	Beatley five-leaf clover	Fabaceae	E RC(NV)	Several locations in Nye & Mineral Cos., NV ranging north to Douglas Co., NV	Volcanic outcrops, flat rock areas & along washes with black sage & pinyon-juniper	5800' (1768 m)	April-June	[25, 51]**
127a	T. [illegible] var. friscanum	Frisco clover	Fabaceae	Not listed in FR	E. slope of Frisco Range W. of Milford, Iron Co., UT.	Rocky outcrops with shadscale and bud-sage in scattered pinyon-juniper.	5500'	June	** [33]
128	T. lemmonii Gray		Fabaceae	T RT(NV)	Western NV, Sierra Co., CA	Slopes and valleys sagebrush scrub; Yellow Pine Forest	5000-7000' (1524-2134 m)	June-July	[22]
129	Viola purpurea Kellogg var. charlestonensis (Baker & Clausen) Welsh & Reveal	Limestone violet	Violaceae	T RT(NV) RT(UT)	Beaver Dam Mtns., Washington Co., UT and Charleston Mtns., Clark Co., NV.	Limestone outcrops & cliffs, humus soil, yellowpine forest & mixed mtn shrub community	6850-9800' (2074-2898 m)	May	[20]
129a	Zigadenus vaginatus (Rydb.) Baker & Clausen ex. Clokey Macbr.	Sheathed deathcamas	Liliaceae	RT(UT)	Grand, Kane & San Juan Cos., UT, may occur in NV	Hanging gardens & canyon bottoms along seeps	3700-6200' (1129-1891 m)	August-September	At Lake Powell [20]

[a] Corresponds to legend on map showing known locations

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[b] Based on information from Federal Register lists, July 1, 1975 and June 16, 1976, Northern Nevada Native Plant Society (NNNPS) 1980 and Welsh & Thorne, 1979

[c] E = Listed as candidate endangered in FR, 1976. T = listed as candidate threatened in FR, 1975. FE = Federally protected as endangered (DOI). FT = Federally protected as threatened (DOI). SE = State protected as critically endangered (Nevada Forestry Division under NRS 527.270). Utah has no state protected rare plant species. RE = Recommended for endangered status by authorities in Nevada or Utah. RT = Recommended for threatened status by authorities in Nevada or Utah. RC = Recommended as species of special concern by authorities in Nevada or Utah. RD = Recommended to be delisted by authorities in Nevada or Utah.

[d] Numbers refer to reference list

Note: Plants listed as "E" or "T" in status column were removed from federal candidate status effective November, 1980. A revised list is being prepared by the U.S. F. & W. S. (Macbryde, Aug. 1980).

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Table 3.2.2.8-2. Substrate types and rare plants that often occur on them (Page 1 of 2).

Species which occur near thermal springs, seeps *Castilleja salsuginosa* *Centaurium namophilum* *Cymopterus basalticus* *Eriogonum argophyllum*
Species which occur in sandy washes and on flats—Mojave Desert Region *Astragalus geyeri* var. *triquetrus* *A. nyensis* *Penstemon fructiciformis* var. *amargosae* *Phacelia anelsonii*
Species which occur on sand dunes and deep sandy soils *Astragalus callithrix* *A. lentiginosus* var. *micans* *A. pseudiodanthus* *Cymopterus ripleyi* *Eriogonum ammophilum* *E. concinnum* *Helianthus deserticolus* *Penstemon arenarius* *Thelypodium laxiflorum*
Species which occur on limestone, Sevy dolomite or gypsum (valley floors) *Arabis shockleyi* *Asclepias eastwoodiana* *Astragalus pterocarpus* *A. uncialis* *Coryphantha vivipara* *Cryptantha compacta* *Eriogonum eremicum* *E. nummulare* *E. rubricaule* *Frasera gypsicola* *Lepidium nanum* *Phacelia parishii* *Polygala subspinosa* var. *heterorhyncha* *Sclerocactus polyancistrus* *S. pubispinus*

3514

Table 3.2.2.8-2. Substrate types and rare plants that often occur on them (Page 2 of 2).

Species which occur on outcrops, ridges and cliffs
Agave utahensis var. *eborispina*
Arctomecon merriamii
Arenaria stenomeres
Gilia ripleyi
Species known from bajadas of limestone mountains, with sagebrush, pinyon pines or junipers
Astragalus calycosus var. *monophyllidius*
A. convallarius var. *finitimus*
A. oophorus var. *lonchocalyx*
Coryphantha vivipara var. *rosea*
Cryptantha hoffmanii
C. interrupta
Eriogonum darrovii
E. nummulare
Hulsea vestita var. *inyoensis*
Lupinus holmgrenanus
Species known from Sevy dolomite in pinyon-juniper woodland (Pine, Hamlin, Wah Wah Valleys)
Cryptantha compacta
Eriogonum eremicum
E. natum
Penstemon concinnus
P. nanus
Sphaeralcea caespitosa
Species which occur in mountainous areas
Astragalus lentiginosus var. *latus*
Eriogonum natum
Frasera pahutensis
Gilia nyensis
Lewisia maguirei
Lomatium ravenii

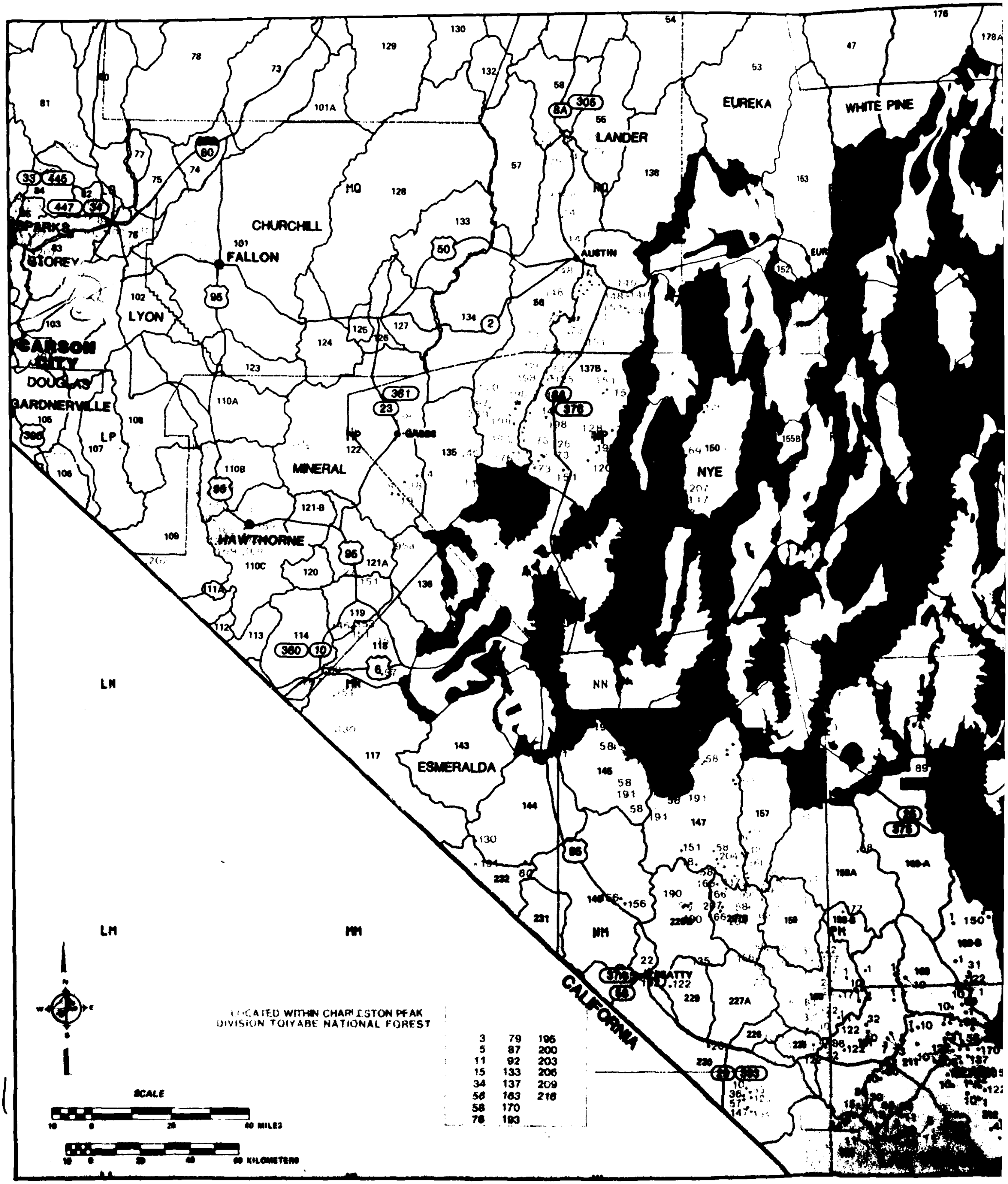
3514

THE CLOKEY PINCUSHION CACTUS (*Coryphantha vivipara* var. *rosea*) OCCURS WITH BLACK SAGEBRUSH ON SHALLOW, WELL DRAINED SOILS. THE SPECIES IS THREATENED BY COLLECTORS.

2035 A

RARE PLANTS LEGEND

NUMBER	SPECIES
1	*Agave utahensis* var. *eborispina*
3	*Angelica scabrida*
4	*Antennaria arcuata*
5	*A. soliceps*
6	*Arabis dispar*
8	*Arctomecon californica*
9	*A. humilis*
10	*A. merriamii*
11	*Arenaria kingii* var. *rosea*
12	*A. stenomeres*
14	*Asclepias eastwoodiana*
15	*Astragalus aequalis*
16	*A. alvordensis*
17	*A. ampullarius*
18	*A. beatleyae*
19	*A. callithrix*
20	*A. calycosus* var. *monophylidius*
21	*A. convallarius* var. *finitimus*
22	*A. funereus*
23	*A. geyeri* var. *triquetrus*
24	*A. lancearius*
25	*A. lentiginosus* var. *latus*
26	*A. l.* var. *micans*
27	*A. l.* var. *sesquimetralis*
28	*A. l.* var. *ursinus*
29	*A. limnocharis*
30	*A. mohavensis* var. *hemigyrus*
31	*A. musimonum*
32	*A. nyensis*
33	*A. perianus*
34	*A. oophorus* var. *clokeyanus*
35	*A. o.* var. *lonchocalyx*
36	*A. phoenix*
37	*A. porrectus*
38	*A. pseudiodanthus*
39	*A. pterocarpus*
39a	*A. robbinsii* var. *occidentalis*
40	*A. serenoi* var. *sordescens*
41	*A. solitarius*
42	*A. striatiflorus*
43	*A. tephrodes* var. *eurylobus*
44	*A. toquimanus*
45	*A. uncialis*
48	*Calochortus striatus*
49	*C.* sp. (Ash Meadows)
50	*Camissonia megalantha*
51	*C. nevadensis*
53	*Castilleja parvula*
54	*C. salsuginosa*
55	*Centaurium namophilum*
56	*Cirsium clokeyi*
57	*Cordylanthus tecopensis*
58	*Coryphantha vivipara* var. *rosea*
59	*Cryptantha compacta*
60	*C. hoffmannii*
61	*C. insolita*
62	*C. interrupta*
63	*C. tumulosa*
64	*Cuscuta warneri*
65	*C. basalticus*
67	*Cymopterus coulteri*
68	*C. minimus*
69	*C. nivalis*
71	*C. goodrichii*
72	*Dalea kingii*
73	*Draba arida*
74	*D. asperella* var. *zionis*
75	*D. asterophora* var. *asterophora*
76	*D. crassifolia* var. *nevadensis*
78	*D. jaegeri*
79	*D. paucifructa*
79a	*D. sobolifera*
80	*D. sphaeroides* var. *cusickii*
81	*D. stenoloba* var. *ramosa*
82	*D. subalpina*
83	*Echinocereus engelmannii* var. *purpureus*
84	*Elodea nevadensis*
85	*Enceliopsis nudicaulis* var. *corrugata*
87	*Epilobium nevadense*
88	*Erigeron latus*
89	*E. ovinus*
90	*E. proselyticus*
91	*E. religiosus*
92	*E. uncialis* var. *conjugans*
93	*Eriogonum ammophilum*
94	*E. anemophilum*
95	*E. argophyllum*
95a	*E. beatleyae*
96	*E. bifurcatum*
98	*E. corymbosum* var. *matthewsiae*
99	*E. darrovii*
100	*E. eremicum*
101	*E. holmgrenii*
102	*E. jamesii* var. *rupicola*
103	*E. lemmonii*
104	*E. lobbii* var. *robustius*
105	*E. natum*
105a	*E. nummulare*
106	*E. ostlundii*
109	*E. panguicense* var. *alpestre*
110	*E. rubricaule*
111	*E. thompsonae* var. *albiflorum*
112	*E. viscidulum*
113	*E. zion* var. *zionis*
115	*Forsellesia pungens*
116	*Frasera gypsicola*
117	*F. pahutensis*
118	*Fraxinus cuspidata* var. *macropetala*
119	*Galium hilendiae* ssp. *kingstonense*
120	*Geranium toquimense*
121	*Gilia nyensis*
122	*G. ripleyi*
123	*Grindelia fraxino-pratensis*
124	*Hackelia ophiobia*
125	*H. alpinus*
128	*H. watsoni*
129	*Helianthus deserticolus*
130	*Heuchera duranii*
132	*Hymenopappus filifolius* var. *tomentosus*
133	*Ivesia cryptocaulis*
134	*I. eremica*
135	*Lathyrus hitchcockianus*
136	*Lepidium nanum*
136a	*L. ostleri*
137	*Lesquerella hitchcockii*
138	*Lewisia maguirei*
140	*Lomatium ravenii*
142	*Lupinus jonesii*
143	*L. malacophyllus*
144	*L. montigenus*
145	*Machaeranthera grindelioides* var. *depressa*
146	*M. leucanthemifolia*
147	*Mentzelia leucophylla*
148	*Mertensia toiyabensis*
149	*Mimulus washoensis*
150	*Mirabilis pudica*
151	*Opuntia pulchella*
152	*O. whipplei* var. *multigeniculata*
153	*Oryctes nevadensis*
154	*Oxytheca watsonii*
155	*Pediocactus sileri*
156	*Penstemon arenarius*
157	*P. bicolor* spp. *bicolor*
158	*P. b.* spp. *roseus*
159	*P. concinnus*
160	*P. francisci-pennellii*
161	*P. fruticiformis* spp. *amargosae*
162	*P. humilis* var. *obtusifolius*
163	*P. keckii*
165	*P. nanus*
166	*P. pahutensis*
167	*P. procerus* var. *modestus*
168	*P. pudicus*
169	*P. rubicundus*
170	*P. thompsoniae* spp. *jaegeri*
171	*P. thurberi* var. *anestius*
172	*P. tidestromii*
173	*P. wardii*
173a	*P.* sp. (Deep Creek Mtns.)
174	*Perityle megalocephala* var. *intricata*
175	*Peteria thompsonae*
176	*Phacelia anelsonii*
176a	*P. argillaceae*
177	*P. beatleyae*
178	*P. cephalotes*
179	*P. glaberrima*
180	*P. inconspicua*
183	*P. parishii*
184	*Phlox gladiformis*
186	*Polygala subspinosa* var. *heterorhyncha*
187	*Primula capillaris*
188	*P. nevadensis*
189	*Rorippa subumbellata*
190	*Salvia funerea*
191	*Sclerocactus polyancistrus*
192	*S. pubispinus*
193	*Selaginella utahensis*
195	*Silene clokeyi*
196	*S. petersonii* var. *minor*
197	*S. scaposa* var. *lobata*
198	*Smelowskia holmgrenii*
199	*Sphaeralcea caespitosa*
200	*Sphaeromeria compacta*
201	*S. ruthiae*
202	*Streptanthus oliganthus*
203	*Synthyris ranunculina*
204	*Thelypodium laxiflorum*
205	*T. sagittatum* var. *ovalifolium*
206	*Townsendia jonesii* var. *tumulosa*
207	*Trifolium andersonii* spp. *beatleyae*
207a	*T. a.* var. *friscanum*
208	*T. lemmonii*
209	*Viola purpurea* var. *charlestonensis*
214	*Cymopterus newberryi*
216	*Ditaxis diversiflora*
219a	*Haplopappus abberans*
230	*Polemonium nevadensae*


EUREKA
WHITE PINE
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SPARKS
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MINERAL
HAWTHORNE
AUSTIN
NYE
ESMERALDA
BEATTY
CALIFORNIA
LOCATED WITHIN CHARLESTON PEAK
DIVISION TOIYABE NATIONAL FOREST
3 79 195
5 87 200
11 92 203
15 133 206
34 137 209
56 163 216
58 170
76 193
SCALE
MILES
KILOMETERS

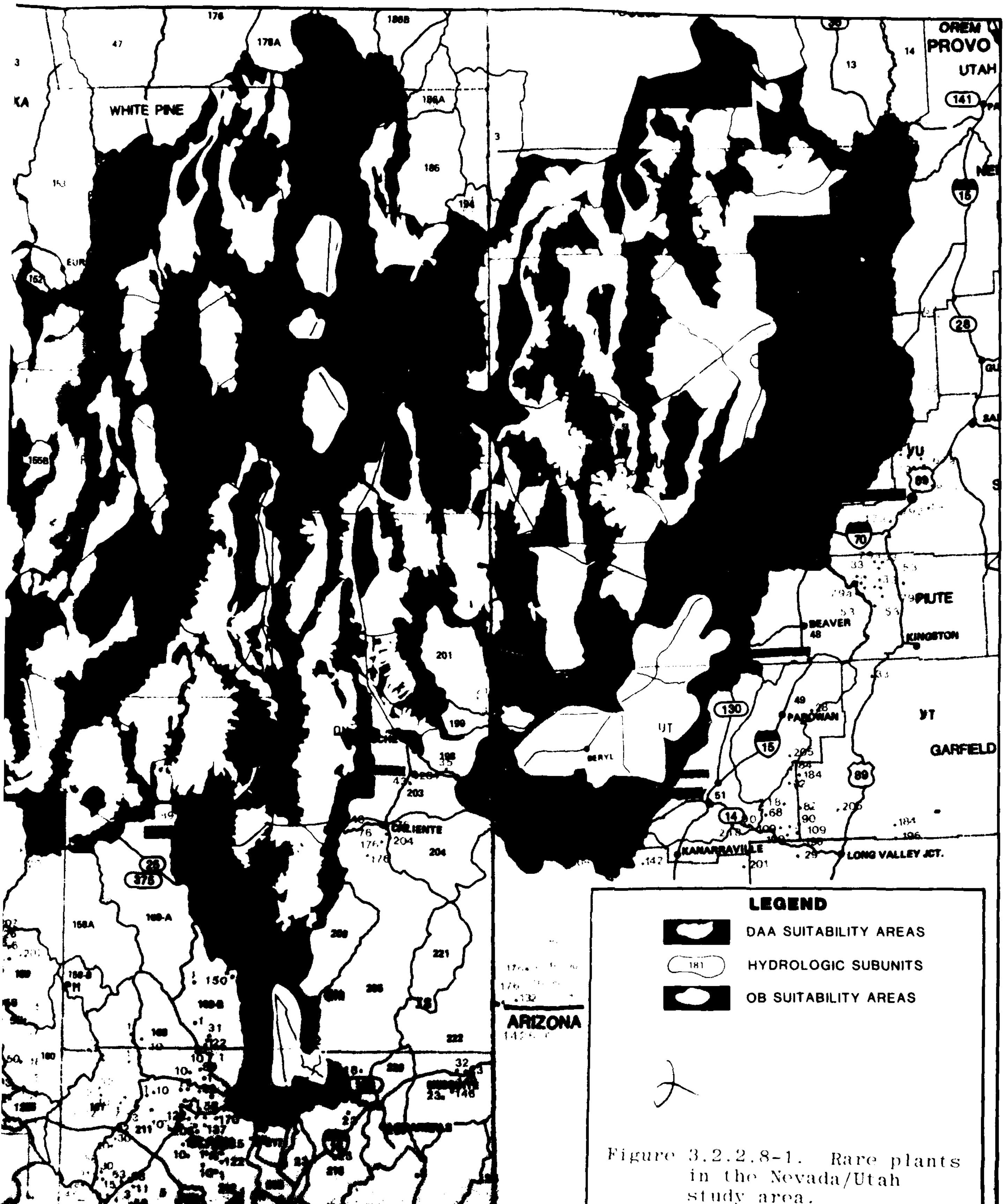


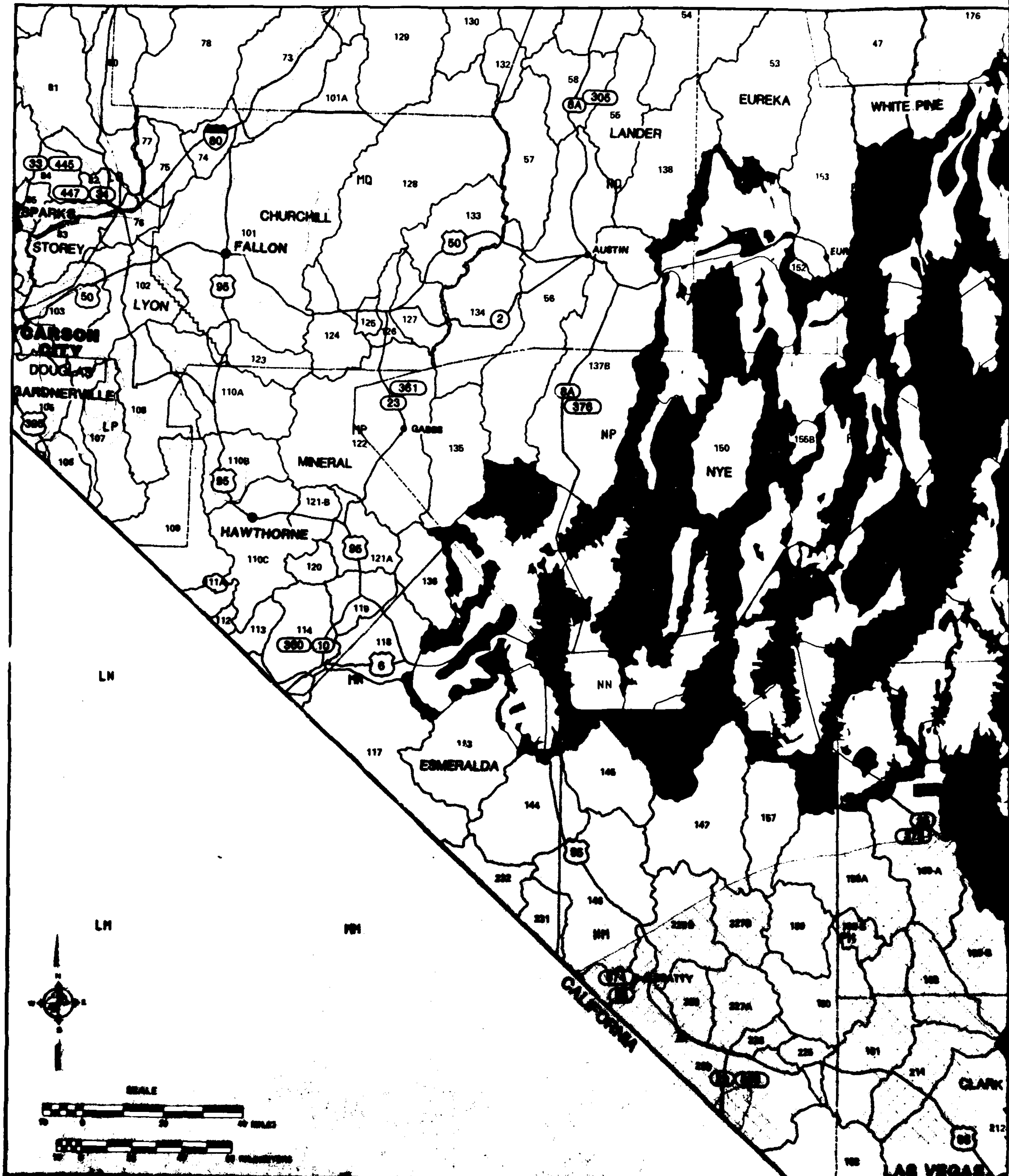
Figure 3.2.2.8-1. Rare plants in the Nevada/Utah study area.

3222-D

THREATENED AND ENDANGERED WILDLIFE SPECIES

LEGEND

- BALD EAGLE WINTERING AREA (ESTIMATED)
- • BALD EAGLE KNOWN ROOST SITE
- DESERT TORTOISE RANGE
- DESERT TORTOISE CRITICAL HABITAT
- GILA MONSTER RANGE
- PEREGRINE FALCON: *REGION CONTAINING ACTIVE NESTS SINCE 1960*
- ▲ GUILIANI'S DUNE SCARAB BEETLE RANGE
- ● SPOTTED BAT SIGHTING
- UTAH PRARIE DOG RANGE



CHURCHILL
FALLON
SPARKS
STOREY
LYON
CARSON CITY
DOUGLAS
GARDNERVILLE
MINERAL
HAWTHORNE
ESMERALDA
LANDER
AUSTIN
EUREKA
WHITE PINE
NYE
CLARK
LAS VEGAS
CALIFORNIA
SCALE

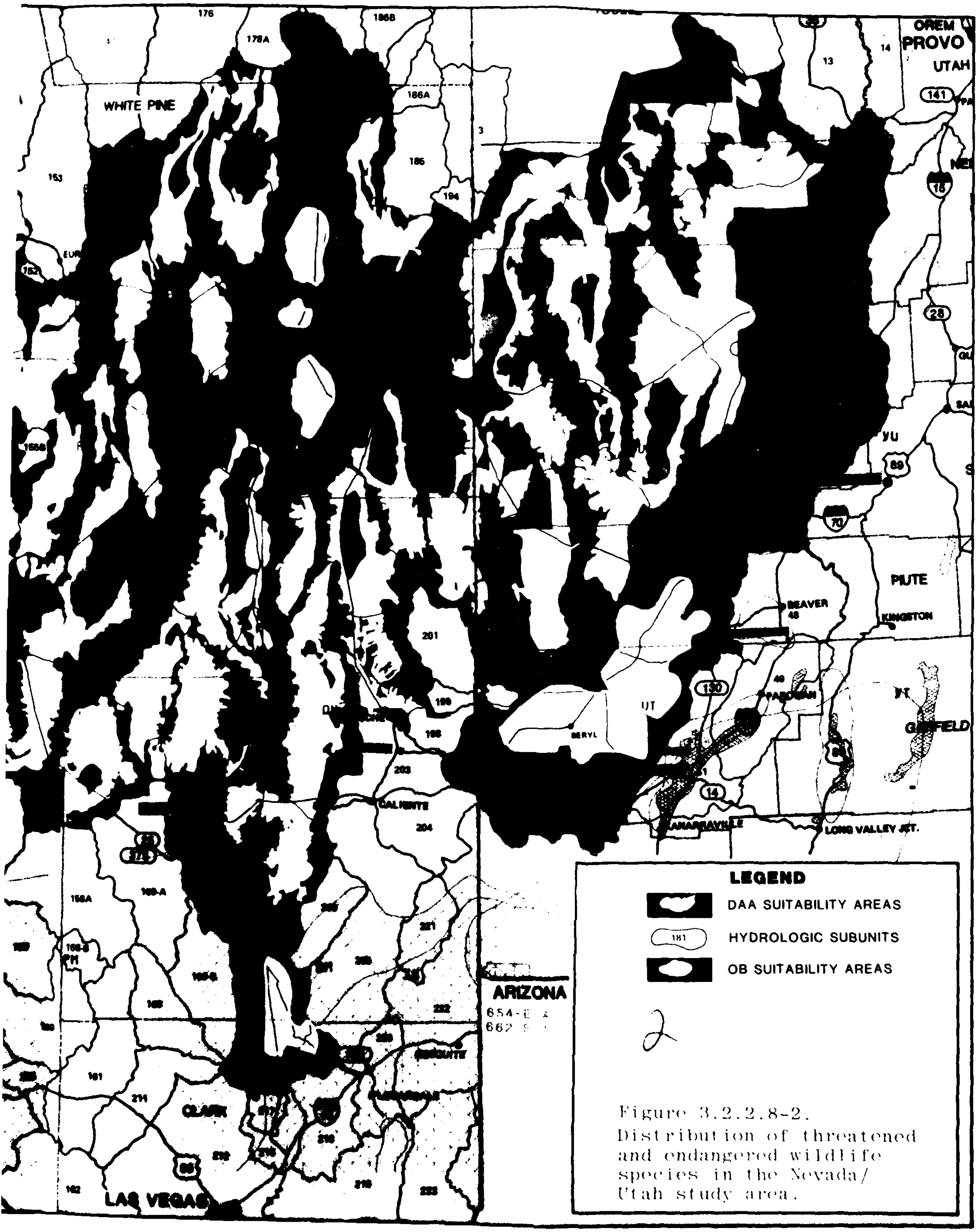


Figure 3.2.2.8-2.
Distribution of threatened and endangered wildlife species in the Nevada/Utah study area.

3222-D

Table 3.2.2.8-3. Summary of the legal status of protected and recommended protected fish in the Nevada/Utah study area.

COMMON NAME	SCIENTIFIC NAME	PRESENT CLASSIFICATION		RECOMMENDED CLASSIFICATION			MAP SYMBOL
		FEDERAL	STATE	DEACON et al. (1979)	HARDY (1981a)	HARDY (1980)	
Killifishes (Cyprinodontidae)							
Ash Meadows Amargosa Pupfish	*Cyprinodon nevadensis mionectes*		T	T			A
Devil's Hole Pupfish	*C. diabolis*	E	E	E			H
Warm Springs Amargosa Pupfish	*C. nevadensis pectoralis*	E	T	E			I
Pahrump Killifish	*Empetrichthys latos latos*	E	T	E			N
Railroad Valley Springfish	*Crenichthys nevadae*		T	SC			E
Preston White River Springfish	*C. baileyi albivallis*		T	T	SC/T		L, 1
Mormon White River Springfish	*C. b. thermophilus*		T	T	SC/T		L, 2
Hiko White River Springfish	*C. b. grandis*		T	T	SC/T		L, 3a
White River Springfish	*C. b. baileyi*		T	T	E		L, 3
Moapa White River Springfish	*C. b. moapae*		T	T	SC		L, 3b
Minnows (Cyprinidae)							
Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*			E	T/E		4
Independence Valley Speckled Dace	*R. o. lethoporus*			E			5
Clover Valley Speckled Dace	*R. o. oligoporus*			E			
Moapa Speckled Dace	*R. o. moapae*			T	T/SC		6
White River Speckled Dace	*R. o. velifer*				T/E		18
Moapa Dace	*Moapa coriacea*	E	T	E			[illegible]
Fish Creek Spring Tui Chub	*Gila bicolor euchila*			E	E/T		13
Independence Valley Tui Chub	*G. b. isolata*			T	T/E		11
Newark Valley Tui Chub	*G. b. newarkensis*			SC	SC/T		8
Lahontan Tui Chub	*G. b. obesa*			SC	T/E		[illegible]
Pahranagat Roundtail Chub	*G. robusta jordani*	E	E	E			L
Virgin River Roundtail Chub	*G. r. seminuda*		SC*	E	T		S
Least Chub	*Iotichthys phlegethontis*		T*	T			2
White River Spinedace	*Lepidomeda albivalis*		T	T	T/E	E	J
Virgin Spinedace	*L. mollispinis mollispinis*		T*	T			R
Big Spring Spinedace	*L. m. pratensis*			E			I
Woundfin	*Plagopterus argentissimus*	E	T, E*	E	E		T
Relict Dace	*Relictus solitarius*		T	SC	T/SC		[illegible]
Suckers (Catostomidae)							
White River Desert Sucker	*Catostomus clarki intermedius*		T	T	SC/T	E	K
June Sucker	*C. liorus*		E*	SC			14
Cui-ui	*C. cujus*	E	E	E			9
Trout (Salmonidae)							
Lahontan Cutthroat Trout	*Salmo clarki henshawi*	T		T			P
Utah Snake Valley Cutthroat Trout	*S. c. utah*		E	T			F
Humboldt Lahontan Cutthroat Trout	*S. c. ssp.*			SC			17
Sculpin (Cottidae)							
Bear Lake Sculpin	*Cottus echinatus*			E			16

*Utah state protected. T20-1

SC = Special Concern

T = Threatened

E = Endangered

LEGEND

PROTECTED FISH SPECIES FOR NEVADA AND UTAH

A ASH MEADOWS AMARGOSA PUPFISH
B CUI-UI*
C RELICT DACE
E RAILROAD VALLEY SPRINGFISH
F UTAH OR SNAKE VALLEY CUTTHROAT TROUT
G WARM SPRINGS AMARGOSA PUPFISH
H DEVILS HOLE PUPFISH*
I BIG SPRING SPINEDACE
J WHITE RIVER SPINEDACE
K WHITE RIVER DESERT SUCKER
L WHITE RIVER SPRINGFISH
M PAHRANAGAT ROUNDTAIL CHUB*
N PAHRUMP KILLIFISH*
O MOAPA DACE*
P LAHONTAN CUTTHROAT TROUT*
R VIRGIN SPINEDACE
S VIRGIN RIVER ROUNDTAIL CHUB
T WOUNDFIN*
U LEAST CHUB

* Federally protected

RECOMMENDED PROTECTED FISH SPECIES FOR NEVADA AND UTAH

1 PRESTON WHITE RIVER SPRINGFISH
2 MORMON WHITE RIVER SPRINGFISH
3 WHITE RIVER SPRINGFISH
3a HIKO WHITE RIVER SPRINGFISH
3b MOAPA WHITE RIVER SPRINGFISH
4 ASH MEADOWS SPECKLED DACE
5 INDEPENDENCE VALLEY SPECKLED DACE
6 CLOVER VALLEY SPECKLED DACE
7 MOAPA SPECKLED DACE
8 NEWARK VALLEY TUI CHUB
9 LAHONTAN TUI CHUB
10 ALVORD CHUB
11 INDEPENDENCE VALLEY CHUB
12 SHELDON TUI CHUB
13 FISH CREEK SPRINGS TUI CHUB
14 JUNE SUCKER
16 UTAH LAKE SCULPIN
17 HUMBOLDT LAHONTAN CUTTHROAT TROUT
18 WHITE RIVER SPECKLED DACE
(F) UTAH OR SNAKE VALLEY CUTTHROAT TROUT
(R) VIRGIN SPINEDACE

RECOMMENDED PROTECTED INVERTEBRATES

MOLLUSCS

19 OVERTON ASSIMINEA
20 MOAPA VALLEY TURBAN
21 ASH MEADOWS TURBAN
22 PAHRANAGAT VALLEY TURBAN
23 HOT CREEK TURBAN
24 STEPTOE TURBAN
25 WHITE RIVER VALLEY FONTELICELLA
26 [illegible] VALLEY FONTELICELLA
27 CURRENT FONTELICELLA
28 DUCKWATER FONTELICELLA
29 RED ROCK FONTELICELLA
30 WHITE RIVER VALLEY HYDROBIID
31 DUCKWATER [illegible]
32 CORN CREEK [illegible]
33 ASH MEADOWS TRYONIA
34 MOAPA TRYONIA
35 [illegible] CANYON [illegible]
36 [illegible]

INSECTS

DIPTERANS

37 VIRGIN RIVER NET WINGED MIDGE

HEMIPTERANS

38 ASH SPRINGS CREEPING WATER BUG
39 MOAPA CREEPING WATER BUG

PLECOPTERANS

40 [illegible] STONEFLY NYMPH

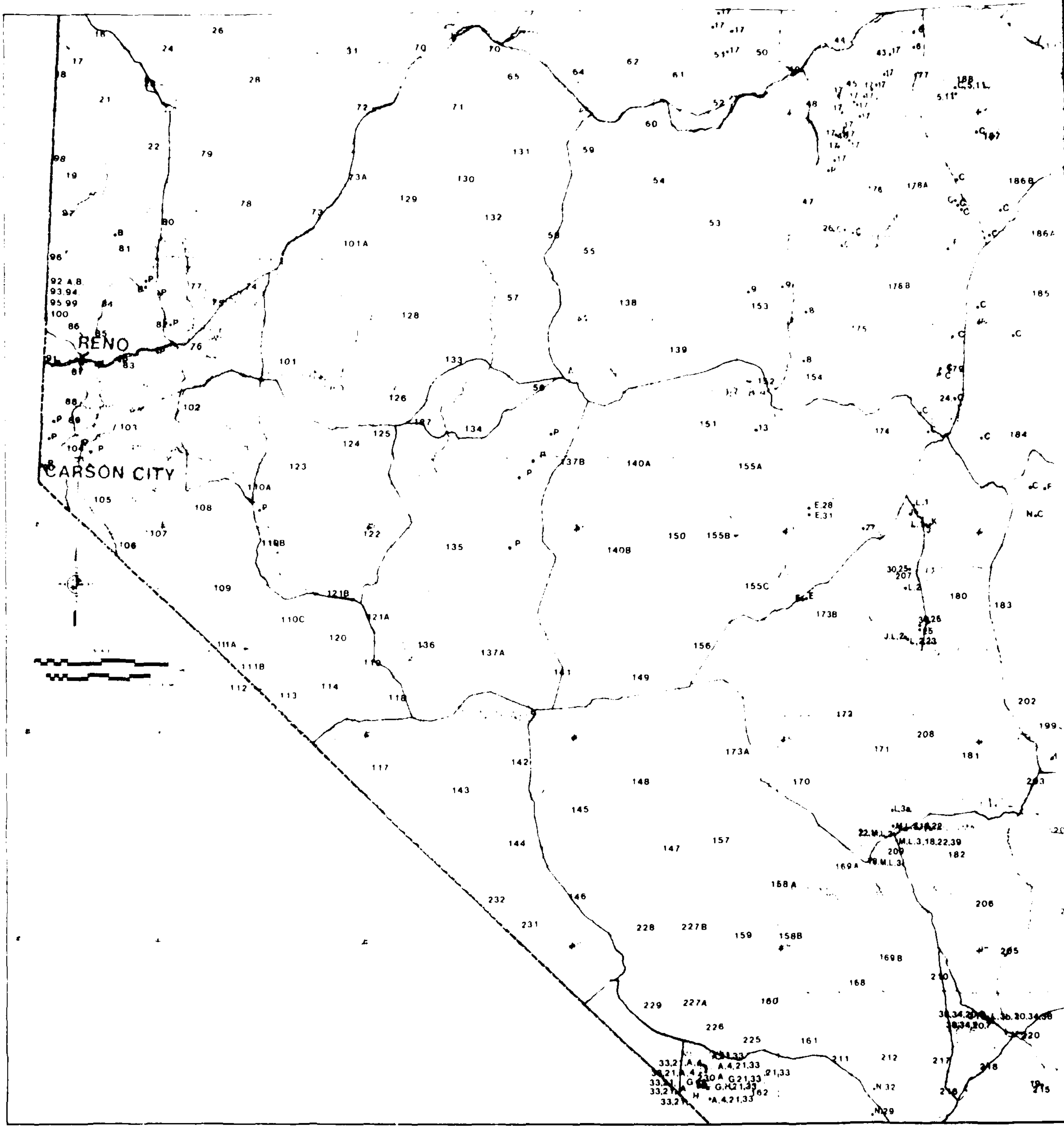
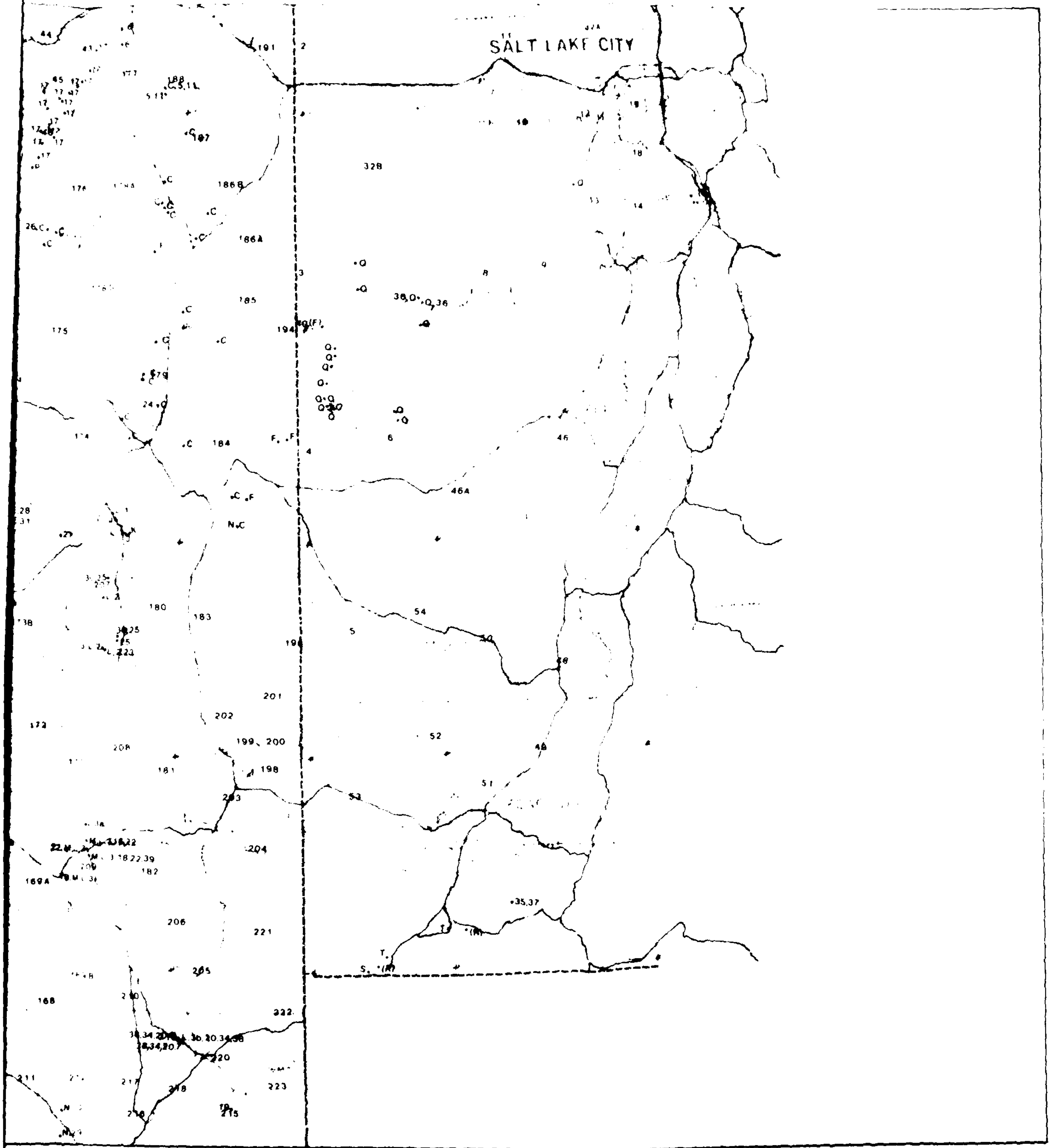


Figure 3.2.2.8-3. Protected fish species in the



d fish species in the Nevada/Utah study area.

2

Table 3.2.2.8-4. Summary of the recommended protected invertebrates in the Nevada/Utah study area.

[illegible] NAME	[illegible] NAME	[illegible]	[illegible]	[illegible] TYPE
Mollusks-Gastropods				
[illegible]				
Moapa Valley [illegible]	"[illegible]" avernalis	T		[illegible]
Ash Meadows [illegible]	"[illegible]" erythropoma	T		[illegible]
Pahranagat Valley [illegible]	"F." merriami	T		[illegible]
[illegible] Creek [illegible]	"F." n. sp.	T		[illegible]
[illegible]	"F." nevadensis	T E		[illegible]
Assimineidae				
[illegible]	Assiminea n. sp.	T		[illegible]
Hydrobiidae				
White River [illegible]	Fontelicella n. sp.	E		[illegible]
[illegible]	F. n. sp.	T E		[illegible]
[illegible]	F. n. sp.	T E		[illegible]
[illegible]	F. n. sp.	T E		[illegible]
[illegible]	F. n. sp.	T E		[illegible]
White River Valley [illegible]	N. gen., n. sp.	E		[illegible]
[illegible]	N. gen., n. sp.	T E		[illegible]
[illegible]	N. gen., n. sp.	T E		[illegible]
Ash Meadows Tryonia	Tryonia n. sp.	E		[illegible]
Moapa Tryonia	T. clathrata	T E		[illegible]
Physidae				
[illegible] Physa	Physa [illegible]	E		[illegible]
Lymnaeidae				
[illegible] Snail	Lymnaea pilsbryi	T E		[illegible]
Insects				
[illegible] Blephariceridae				
[illegible] River [illegible] Midge	Blepharicera [illegible]		T E	[illegible]
Hemipterans Naucoridae				
Ash Meadows Creeping Water Bug	[illegible]		T E	[illegible]
Moapa Creeping Water Bug	[illegible] moapensis		T E	[illegible]
Plecopterans				
Giant Stonefly Nymph	N. gen., n. sp.		T E	4

N = Novum or new

Sp. = Species

Gen. = Genus

of these species evolved as a result of isolation caused by drying of Pleistocene lakes (10,000-20,000 years ago), forming widely spaced small springs and streams.

Wilderness and Significant Natural Areas (3.2.2.9)

Wilderness (3.2.2.9.1)

No designated wilderness areas are in the study area. Jarbidge in the Humboldt National Forest in northeastern Nevada, and Lone Peak in the Unita and Wasatch National Forest in central Utah, are located 150 and 65 mi, respectively, from the nearest project feature. Portions of the proposed deployment area are undergoing review for wilderness characteristics (Figure 3.2.2.9-1).

Significant Natural Areas (3.2.2.9.2)

Significant natural areas in the proposed siting region include over 70 proposed/designated natural landmarks, seven national wildlife refuges/ranges, four proposed unique and nationally significant wildlife ecosystems, four national parks/monuments, and nine state wildlife management areas (Figure 3.2.2.9-2).

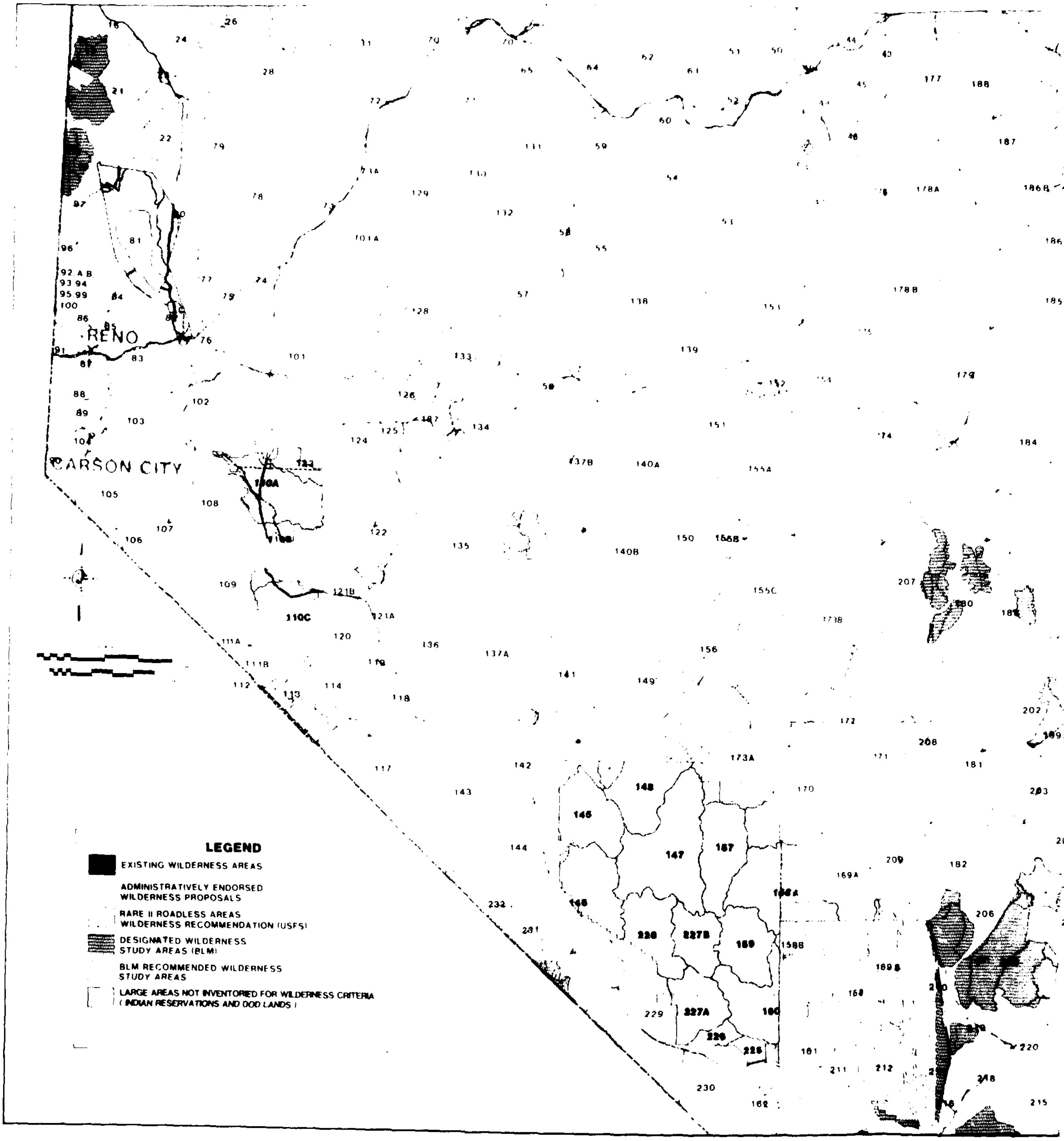
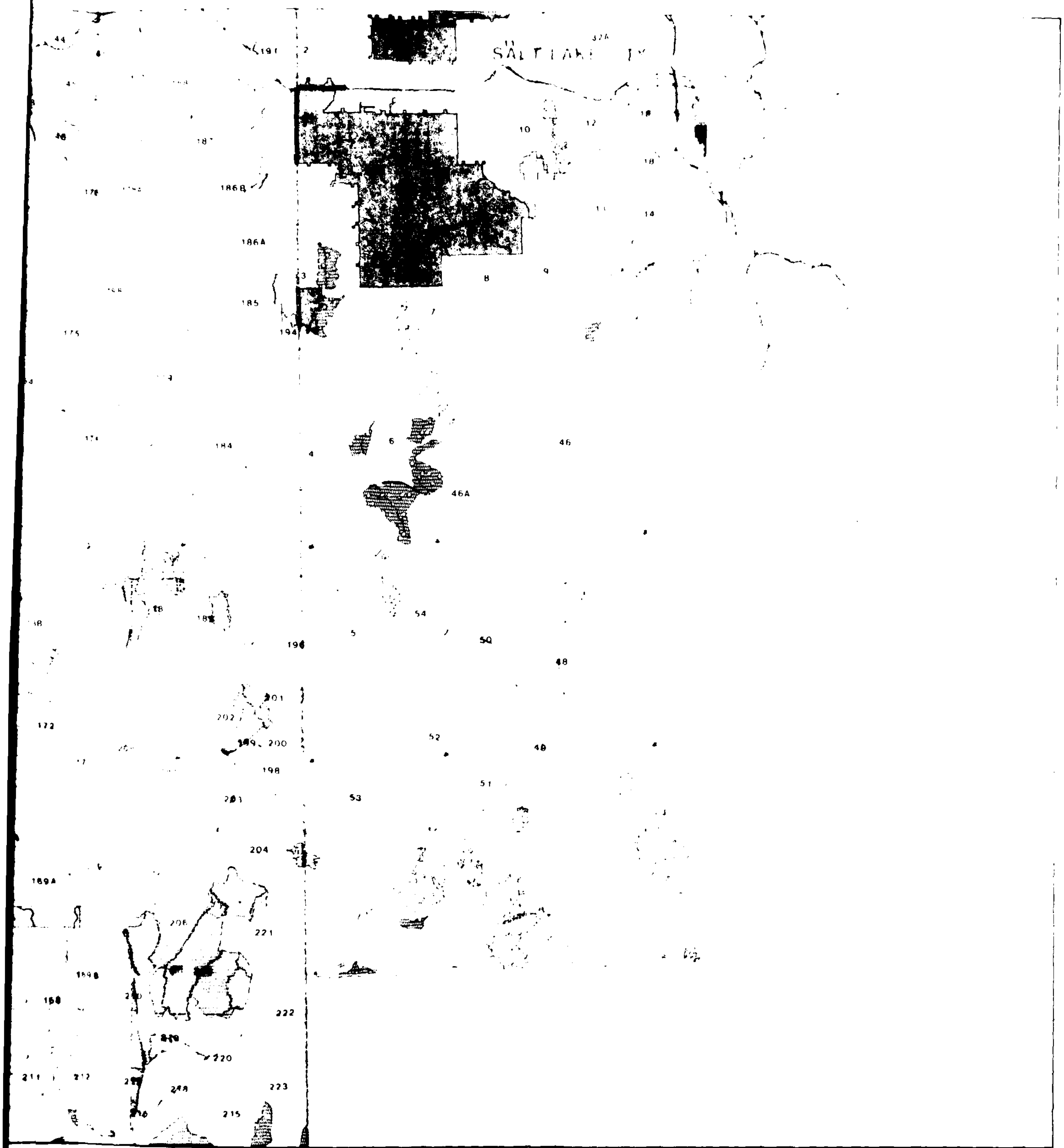


Figure 3.2.2.9-1. Existing and proposed wilderness a



ropos[illegible] [illegible]lderness areas in the Nevada/Utah study area.

2

THE DWARF BEARD TONGUE (*Penstemon nanus*) OCCURS ON GRAVELLY SOIL WITH BLACK SAGEBRUSH, JUNIPER, AND RABBITBRUSH.

2036-A

SIGNIFICANT NATURAL AREAS

LEGEND

1 NATIONAL PARK/MONUMENT

2 NATIONAL WILDLIFE REFUGE/RANGE

3 UNIQUE AND NATIONALLY SIGNIFICANT WILDLIFE ECOSYSTEM

4 NATURAL LANDMARK

5 NATURAL AREA

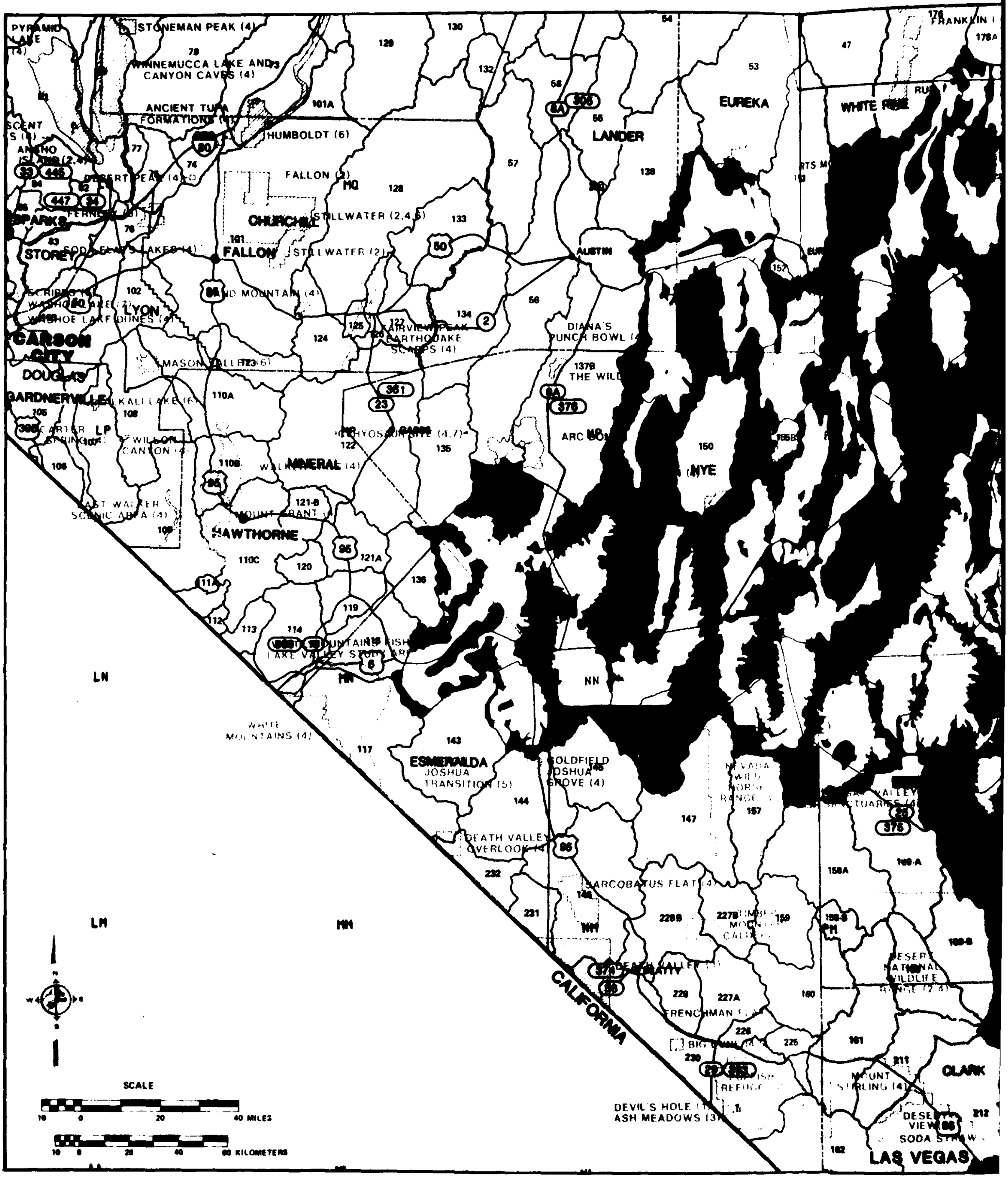
6 STATE WILDLIFE MANAGEMENT AREA

7 STATE PARK

APPROXIMATE BOUNDARY

---- AREAS PROPOSED FOR GREAT BASIN NATIONAL PARK

EXTENDED GEOTECHNICALLY SUITABLE AREAS


STONEMAN PEAK (4)
WINNEMUCCA LAKE AND
CANYON CAVES (4)
ANCIENT TUFA
FORMATIONS
HUMBOLDT (6)
FALLON (2)
STILLWATER (2,4,5)
STILLWATER (2)
CHURCHILL
FALLON
SPARKS
STOREY
LYON
CARSON
CITY
DOUGLAS
GARDNERVILLE
MASON VALLEY
WILSON
CANYON (4)
EAST WALKER
SCENIC AREA (4)
MINERAL
HAWTHORNE
EUREKA
LANDER
AUSTIN
DIANA'S
PUNCH BOWL
FAIRVIEW PEAK
EARTHQUAKE
SCARPS (4)
WHITE PINE
NYE
ESMERALDA
JOSHUA
TRANSITION (5)
GOLDFIELD
JOSHUA
GROVE (4)
DEATH VALLEY
OVERLOOK (4)
SARCOBATUS FLAT
WHITE
MOUNTAINS (4)
CALIFORNIA
FRENCHMAN
DEVIL'S HOLE
ASH MEADOWS (3)
DESERT
NATIONAL
WILDLIFE
RANGE (2,4)
MOUNT
STERLING (4)
CLARK
LAS VEGAS
SODA STRAW
LN
LM
MM
NN
SCALE
40 MILES
60 KILOMETERS

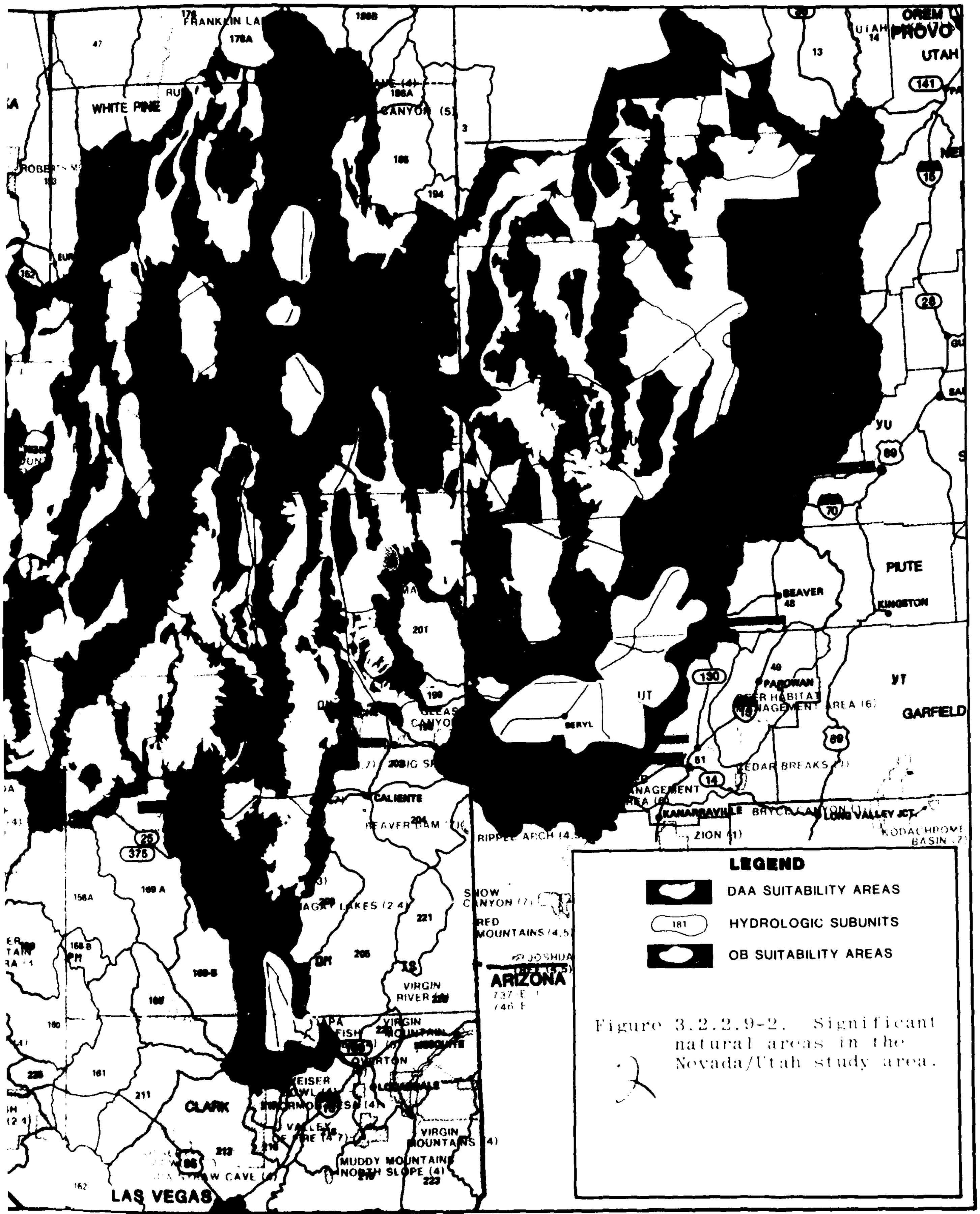
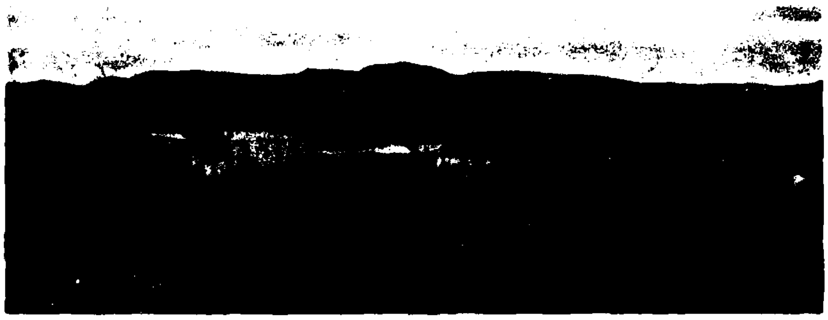


Figure 3.2.2.9-2. Significant natural areas in the Nevada/Utah study area.

3222-D

Nevada/Utah Human Environment



HUMAN ENVIRONMENT (3.2.3)

The designated Nevada/Utah region of influence (ROI) is shown in Figure 3.2.3-1. It includes the Nevada counties of Clark, Eureka, Lincoln, Nye, Washoe, and White Pine, and the Utah counties of Beaver, Iron, Juab, Millard, Salt Lake, Utah, and Washington. Geographic areas analyzed other than the ROI include areas of analysis (AOA) and potential base site locations. For most impacts analyzed the AOAs are synonymous with city and county boundaries. For those attributes which logically cannot be geographically evaluated at the county level (e.g., air quality), the AOA is explicitly defined when baseline data is presented.

Employment (3.2.3.1)

The size of the employed and the unemployed labor force and the unemployment rate are significant measures of the study area economy, since they reflect the labor supply from which project-generated direct and indirect job demands can be filled. Total unemployment is a significant measure of the affected environment, for it is a measure of the region's unused labor pool. In this respect, it is notable that many of the counties in the Nevada/Utah study area have very small unemployed labor pools.

Of the total unemployed in 1977, 9 of the 12 counties had unemployed "pools" of substantially less than 1,000 persons. The other three countes -- Clark, Salt Lake, and Utah counties -- have the bulk of the employed and the unemployed. Substantial construction labor requirements, in the majority, could only be met through large-scale labor importation.

Unemployed-labor pools may understate labor force availability in cases where people are employed part-time but would prefer full employment, and hidden unemployment, where people are not in the civilian labor force (CLF), but might be if suitable jobs became available. However, total unemployment is used as the labor supply variable, since accounting for underemployment and hidden unemployment would be highly speculative. Moreover, for the rural counties, population totals are so modest that no substantial augmentation of supply could be met except by labor importation, whether transient or permanent.

As shown in Table 3.2.3.1-1, the civilian labor force in Nevada has grown rapidly -- 6.4 percent per annum from 1970 to 1977. Unemployment rates were relatively low in 1977 throughout most of Nevada. The Las Vegas and Reno Standard Metropolitan Statistical Areas (SMSAs) -- Clark and Washoe counties, respectively--accounted for 82.2 percent of the state's unemployed in 1977 and 82.0 percent of the civilian labor force. The combination of Carson City (the state capital), Clark, Douglas, and Washoe counties (the tourism centers of Las Vegas, Tahoe South Shore, and Reno), accounted for 88.4 percent of Nevada's 1977 civilian labor force and 90.8 percent of the unemployed in 1977.

Within Utah, unemployment increased from about 17,000 to 25,000 in the 1970-1977 period (Table 3.2.3.1-2). This growth rate of 5.7 percent was accompanied by a 4.4 percent growth rate in the CLF. The unemployment rates for the Utah portion of the ROI are greater than those for Utah. Three counties--Salt Lake, Utah, and Weber--account for 83.8 percent of the civilian labor force. In terms of unemployment, these three counties account for a total of 85.6 percent of the study area's unemployed.

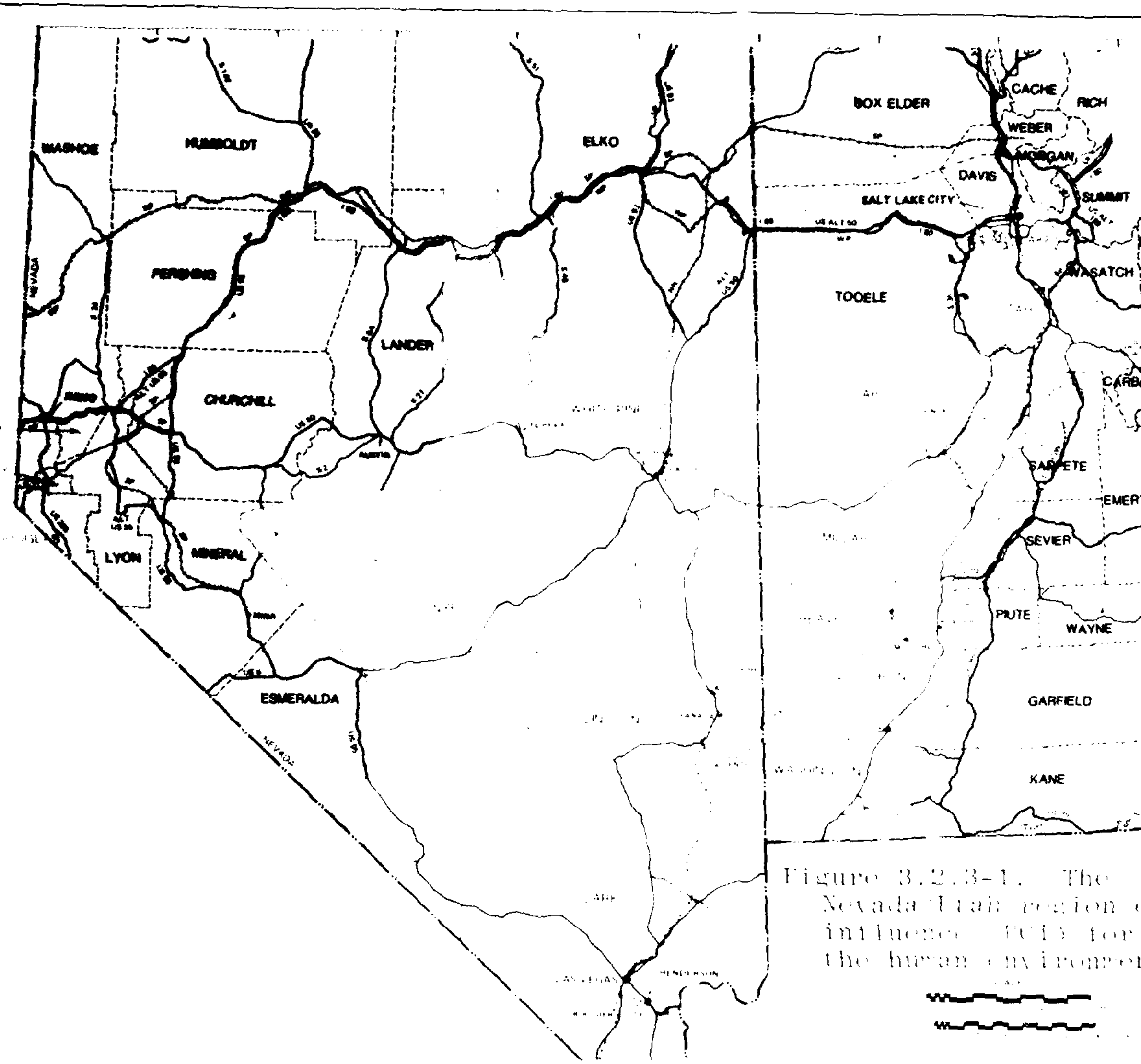


Figure 3.2.3-1. The Nevada-Utah region of influence (ROI) for the human environment.

Table 3.2.3.1-1. Nevada civilian labor force, by place of residence.

COUNTY	CIVILIAN LABOR FORCE*		UNEMPLOYMENT*		UNEMPLOYMENT RATE	
	1977	GROWTH RATE 1970-77	1977	GROWTH RATE 1970-77	1970	1977
Carson City	14,450	12.1	1,530	22.6	5.7	10.6
Churchill	4,830	4.4	360	13.2	7.1	7.5
Clark	174,200	6.3	14,100	13.2	5.2	8.1
Douglass	6,420	9.5	450	7.9	7.7	7.0
Elko	8,620	5.4	400	5.5	4.6	4.6
Esmeralda	200	-1.4	10	-2.6	5.4	5.8
Eureka	560	3.4	20	100.0	0	3.8
Humboldt	3,890	5.2	190	15.1	2.6	4.9
Lander	1,540	5.6	80	22.8	1.8	5.1
Lincoln	1,350	5.5	80	15.6	3.1	5.8
Lyon	3,670	2.3	320	15.6	3.7	8.7
Mineral	2,660	-1.2	160	11.4	2.6	5.9
Nye	1,920	-3.5	100	5.4	2.8	5.1
Pershing	1,360	2.9	80	6.6	4.6	5.9
Storey	680	6.9	50	39.0	1.3	7.6
Washoe	90,500	7.0	4,800	4.6	6.2	5.3
White Pine	3,860	-0.4	300	11.2	3.6	7.8
Total State	323,000	6.4	23,000	10.7	5.4	7.2
U.S.	97,401,000	2.4	6,855,000	7.7	4.9	7.0

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*By place of residence

Sources: U.S. Dept. of Commerce 1978a; Nevada Dept. of Economic Security, 1979.

Table 3.2.3.1-2. Utah civilian labor force, by place of residence.

COUNTY	CIVILIAN LABOR FORCE		UNEMPLOYMENT		UNEMPLOYMENT RATE	
	1977	GROWTH RATE 1970-1977	1977	GROWTH RATE 1970-1977	1970	1977
Beaver	[illegible]	[illegible]	130	13.2	[illegible]	[illegible]
Davis	43,952	3.7	1,967	4.0	4.3	4.5
Iron	6,780	5.1	420	10.3	4.4	6.2
Juab	[illegible]	1.6	150	6.3	5.7	7.2
Millard	3,190	2.2	150	-0.7	5.9	4.7
Salt Lake	255,410	5.[illegible]	13,050	7.1	4.6	5.2
Tooele	9,490	3.7	430	4.2	4.0	5.1
Utah	[illegible],040	5.4	3,520	1.1	4.7	5.[illegible]
Washington	7,320	7.1	370	6.1	3.4	5.2
Weber	57,260	1.7	4,650	6.2	6.0	8.1
Study Area Total	456,382	4.4	25,107	5.7	5.1	5.5
Utah State Total	551,900	4.7	29,500	5.2	5.2	5.3
United States Total	97,401,000	2.4	6,855,000	[illegible]	4.9	7.0

576-1

*By Place of Residence.

Source: Utah Department of Employment Security, 1977; U.S. Department of Commerce, 1978a.

In Nevada, the five counties that comprise that state's portion of the ROI accounted for 56.8 percent of the state's CLF in 1978. In Utah, ROI counties of Beaver, Iron, Juab, Millard, Salt Lake, Utah, and Washington represented 76.0 percent of total state CLF in the same year. In all cases except White Pine and Nye counties, ROI counties had CLF growth rates well above that for the U.S. as a whole over the 1970-1977 period. In contrast, ROI counties had much smaller growth in unemployment than the U.S., but greater than comparable rates for Nevada and Utah as a whole.

Nevada and Utah economic characteristics relative to the national average are shown in Table 3.2.3.1-3. In general, sectoral shares in the Utah state economy are more similar to the national average than those of Nevada. Services sector shares in Nevada are primarily responsible for this dissimilarity. Gaming and other tourist-related activities alone account for over 28 percent of total employment in the state of Nevada. Other significant differences between Nevada and national shares are in the agriculture sector, with one-third the national average, and manufacturing, with about one-fourth of the national average.

Although employment shares in mining are well below the national average, mining earnings shares are equal to the national average in Nevada, and over five times the national average in Utah. Utah has two-thirds the national average in manufacturing employment share and about one and one-half the national average in construction shares.

On the whole, the nation's employment rate has grown only half as fast as Utah's, and one-third as fast as that of Nevada. Leading growth sectors in both states are construction and manufacturing. Nevada construction employment has grown 5.7 times as fast as the nation as a whole.

Nevada

Selected characteristics of the Nevada economy are shown in Table 3.2.3.1-4, where the share of total employment is shown by county and economic sector. The dominance of Carson City, Clark, Douglas, and Washoe is evident in their accounting for almost 90 percent of total state employment in 1977. The total is only about 0.4 percent of the U.S. total, although, as shown in Table 3.2.3.1-5, Nevada employment is growing much faster than in the United States as a whole. This high rate of growth was a function of high growth rates in several of the larger counties--Clark (the Las Vegas SMSA), Carson City, the state capital, Washoe (the Reno SMSA) and Douglas, locale of the Tahoe South Shore entertainment center. Within the ROI, however, Nye County had a large negative growth rate, while Eureka, Lincoln, and White Pine had growth rates lower than Nevada as a whole.

Agriculture has not been important in Nevada, since it provided only 1.4 percent of the jobs in 1977. Within the state, counties with employment shares of at least 10 percent in agriculture included Churchill, Esmeralda, Eureka, Humboldt, Lander, Lincoln, Lyon, and Pershing. Growth in agriculture has been modest, with an annual average growth rate of only 1.0 percent over the 1967-1977 period. Four counties (Nye, Carson City, Storey, and Washoe) had negative growth in agricultural employment and six had rates of growth below the state average. The county with the most rapid growth of agricultural employment--White Pine--is under consideration for M-X facilities and is slated for the White Pine Power Plant.

Table 3.2.3.1-3. Selected economic characteristics of the Nevada/Utah region and the United States.

[illegible]

Table 3.2.3.1-4. Total employment and percent share by major economic sectors for counties in Nevada, 1977.

COUNTY	TOTAL EMPLOYMENT	PERCENT OF TOTAL STATE EMPLOYMENT	AGRICULTURE SHARE (%)	MINING SHARE (%)	CONSTRUCTION SHARE (%)	MANUFACTURING SHARE (%)	[illegible] SHARE (%)	[illegible] (%)
Carson City	14,313	4.1	0.2	0.2	[illegible]	[illegible]	[illegible]	[illegible]
Churchill	5,131	1.5	13.7	(D)	7.2	2.9	[illegible]	11.8
Clark	185,198	53.1	1.7	(D)	5.6	[illegible]	41.4	[illegible]
Douglass	13,365	3.8	2.1	(D)	4.1	[illegible]	68.4	[illegible]
Elko	8,300	3.4	9.9	2.9	4.0	[illegible]	27.1	[illegible]
Esmeralda	368	0.1	16.0	(D)	(D)	N.L.	N.L.	[illegible]
Eureka	620	0.2	70.2	33.7	(D)	(D)	(D)	21.8
Humboldt	3,905	1.1	14.2	(D)	3.3	4.2	18.3	[illegible]
Lander	1,521	0.4	10.0	19.8	(D)	(D)	3.7	[illegible]
Lincoln	1,213	0.3	13.7	12.4	(D)	(D)	(D)	[illegible]
Lyon	3,327	1.0	16.2	16.0	2.6	8.4	7.9	[illegible]
Mineral	2,555	0.7	1.5	0.6	2.3	(D)	16.5	[illegible]
Nye	5,661	1.6	3.1	10.4	1.2	0.8	29.5	13.1
Pershing	1,303	0.4	21.9	(D)	0.8	3.1	(D)	[illegible]
Storey	509	0.1	N.L.	(D)	(D)	2.4	7.5	12.7
Washoe	97,254	27.9	0.3	5.7	7.3	7.0	33.7	15.2
White Pine	3,952	1.1	5.1	17.2	(D)	7.5	12.4	[illegible]
Total State	348,495	100.0	1.4	1.2	5.7	4.3	37.1	18.1
United States	97,848,874		4.2	0.8	4.0	20.1	17.4	18.[illegible]

N.L. = Not listed

Source: Dept. of Commerce, April 1979.

Table 3.2.3.1-5. Nevada employment growth by sector, study area counties, 1967-1977.

COUNTY	TOTAL			AGRICULTURE			MINING			CONSTRUCTION			MANUFACTURING			SERVICES			GOVERNMENT		
	1967	1977	*[a]	1967	1977	*	1967	1977	*	1967	1977	*	1967	1977	*	1967	1977	*	1967	1977	*
Churchill	3,330	5,131	2.7	642	704	0.9	(D)[b]	(D)	(D)	132	141	0.7	66	151	8.6	315	634	7.2	1,611	2,144	2.9
Clark	97,951	145,198	6.0	389	312	-1.8	260	(D)	(D)	3,910	10,280	10.1	3,661	5,593	4.3	40,021	76,582	6.7	18,611	33,384	5.7
Elko	6,027	8,3[illegible]	3.3	255	824	0.9	93	240	9.9	200	335	5.3	62	72	1.5	1,469	2,246	4.3	1,135	1,753	4.4
Esmeralda	319	368	1.5	45	59	2.7	(D)	(D)	(D)	(D)	(D)	(D)	(D)	0	(D)	(D)	[illegible]	(D)	72	133	6.3
Eureka	538	6[illegible]	1.1	120	125	0.4	195	271	3.3	(D)	(L)[c]	(D)	0	(D)	(D)	(D)	(D)	(D)	91	135	4.0
Humboldt	3,048	4,005	2.5	400	551	3.3	254	(D)	(D)	81	127	4.6	(D)	184	(D)	495	714	3.7	638	737	1.5
Lander	1,086	1,521	3.4	123	152	2.1	(D)	605	(D)	(D)	(D)	(D)	0	(D)	(D)	49	57	1.5	204	296	3.8
Lincoln	86[illegible]	1,21[illegible]	3.[illegible]	146	166	1.3	94	151	4.8	(D)	(D)	(D)	(D)	(D)	(D)	30	(D)	(D)	287	440	4.1
Mineral	2,965	2,55[illegible]	-1.5	36	30	-1.8	63	16	-12.8	14	59	15.5	(D)	(L)	(D)	360	421	1.6	1,980	1,538	-2.5
Nye	8,41[illegible]	[illegible],[illegible]61	3.1	233	17[illegible]	-2.8	370	586	4.7	(D)	69	(D)	23	43	6.5	7,256	(D)	(D)	700	3,368	17.0
Pershing	1,154	1,30[illegible]	1.[illegible]	274	286	0.4	98	(D)	(D)	18	11	-4.8	(D)	40	(D)	90	(D)	(D)	222	293	3.0
White Pine	3,514	3,952	1.2	163	[illegible]	5.1	(D)	670	(D)	63	(D)	(D)	(D)	235	(D)	460	192	0.7	626	949	4.2
Region Total	112,870	198,165	5.8	1,094	1,232	1.1	865	2,292	2.2	3,973	10,349	10.0	3,684	5,941	8.5	47,818	77,131	5.7	21,519	37,572	6.2
State Total	200,226	348,495	5.7	4,318	4,748	1.0	3,500	4,331	2.2	8,164	19,837	9.0[d]	6,713	15,136	8.9[d]	74,007	133,352	5.7	38,514	64,632	5.2
U.S. Total (Millions)	82.5	97.8	1.7	4.6	4.2	-1.2	.6	.8	3.0	3.3	3.9	1.6	19.5	19.7	0.1	12.7	17.0	3.0	13.4	67.8	2.5

062-1

[a]* - Average annual growth rate.

[b](D) not shown to avoid disclosure of confidential information.

[c](L) less than 10 wage and salary jobs.

[d]Rate in doubt because of large number of data points withheld by disclosure rules.

Source: BEA, April, 1979.

Mining accounted for 1.2 percent of the state's jobs in 1977. Eureka, Lander, Lincoln, Lyon, Nye, and White Pine had employment shares of 10 percent or more. However, data were not available for a number of other counties because of disclosure rules. Mining grew statewide at an annual growth rate of 2.2 percent, below that for the United States. Within the ROI, mining employment was well above the average growth rate in Lincoln and Nye counties.

Construction had a larger share of the state's employed labor force -- 5.7 percent -- and was greater than the national average of 4.0 percent in 1977. Over the 1967-1977 period, though, high rates of growth in construction employment were observed in Clark, Elko, Mineral, Carson City, Douglas, and Washoe counties. In general, high rates were characteristic of the more urban areas with lower increases in the more rural counties.

Manufacturing employment grew at a rapid rate over the 1967-1977 period, but it accounted for only 4.3 percent of the total in 1977 (Table 3.2.3.1-5). The nation's percent share of manufacturing--20.1 percent of total employment--indicates that in this respect, Nevada is atypical. While disclosure rules have limited available data, it is clear that wide differences exist in growth of manufacturing across the counties. Over 1967-1977, average annual growth equalled 4.3 for Clark, 26.9 percent for Carson City, 18 percent in Douglas, and 11.8 percent in Washoe counties, for example, while the state figure over this same period was about 9 percent.

Services grew at the same rate as total employment in Nevada, 5.7 percent per annum over the 1967-1977 period, and this sector clearly dominates state employment (37.1 percent in 1977). The chief contributors were the counties of Clark, Douglas, and Washoe, since the hotels, motels, gaming, entertainment, and related services are concentrated there. These three counties had a service industry growth more rapid than the state as a whole, 6.7 percent per annum for Clark (Las Vegas), 6.2 percent for Douglas, and 6.6 percent for Washoe (Reno) over the 1967-1977 period.

In the government sector, Nevada's 18.4 percent share of the total was almost the same as that for the nation. The variation from county to county is quite large, however, for example, 5.5 percent in Douglas as opposed to 60.2 percent in Mineral County. Government was the major job source in Lincoln and White Pine counties. The government sector has exhibited an average annual growth of 5.2 percent over 1967-1977 -- more than twice that of the United States. Above average growth rates were recorded for Clark and Nye counties.

Utah

Of Utah's total employed work force in 1977, 60.2 percent were working in Salt Lake and Utah counties--two of the seven counties in that state comprising the region of influence (see Table 3.2.3.1-6). The remaining five counties, however--Juab, Beaver, Millard, Iron, and Washington--were much smaller contributors to total state employment; their 1977 share equalled only 3.7 percent of the Utah total. Utah had an employment growth rate of 3.5 percent from 1967-1977 (Table 3.2.3.1-7), double that for the nation as a whole. Of the ROI counties, Salt Lake and Utah grew fastest, except for Washington County. Other rural counties grew slowly, with Juab County exhibiting a 0.2 percent average annual growth rate--the lowest of

Table 3.2.3.1-6. Total employment and percent share by major economic sectors for selected counties in Utah, 1977.

COUNTY	TOTAL EMPLOYMENT 1977	PERCENT OF TOTAL STATE EMPLOYMENT	AGRICULTURE SHARE (%)	MINING SHARE (%)	CONSTRUCTION SHARE (%)	MANUFACTURE SHARE (%)	SERVICES SHARE (%)	GOVERNMENT SHARE (%)
Beaver	1,726	0.3	18.2	1.3	2.6	8.6	(D)	20.4
Davis	50,061	9.1	2.2	0.1	4.6	9.3	9.2	51.4
Iron	6,517	1.2	9.4	3.9	5.0	6.2	9.8	26.7
Juab	2,150	0.4	13.2	(D)	(D)	25.8	7.3	20.7
Millard	3,416	0.6	30.9	1.8	1.2	6.8	6.4	21.4
Salt Lake	272,043	49.4	0.5	2.3	5.9	13.9	16.8	17.3
Tooele	10,959	2.0	3.1	0.6	10.0	9.7	4.5	57.1
Utah	59,393	10.8	4.6	7.0	6.1	20.0	20.6	16.6
Washington	6,365	1.2	6.9	0.4	7.0	7.9	11.9	21.1
Weber	49,011	8.9	2.3	0.1	4.8	11.4	11.5	30.2
Utah State Total	550,214		3.7	2.7	5.8	13.5	14.7	23.2
U.S.	97,898,874		4.2	4.2	4.0	20.1	17.4	18.2

060

(D) Not shown to avoid disclosure of confidential data.

Source: Bureau of Economic Analysis, April 1979.

Table 3.2.3.1-7. Employment growth by sector, selected counties in Utah, 1967-1977.

COUNTY	TOTAL			AGRICULTURE			MINING			CONSTRUCTION			MANUFACTURING			[illegible]			GOVERNMENT		
	1967	1977	Δ[1]	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ
Beaver	1,625	1,726	0.6	340	312	-0.9	(D)	23	(D)	(D)	45	(D)	(D)	149	(D)	120	[illegible]	(D)	61	352	[illegible]
Davis	40,034	50,061	2.3	1,231	1,084	-1.3	49	14	-11.8	210	2,323	[illegible]	3,132	[illegible]	4.1	2,041	[illegible]	[illegible]	[illegible]	[illegible]	-0.6
Iron	4,499	6,517	3.8	671	610	-0.9	244	255	0.4	176	327	6.4	270	105	1.1	[illegible]	[illegible]	[illegible]	1,171	1,343	1.2
Juab	2,116	2,150	0.2	343	284	-1.9	198	(D)	(D)	(D)	(D)	(D)	436	554	[illegible]	[illegible]	[illegible]	[illegible]	487	115	-0.8
Millard	2,944	3,416	1.5	1,073	1,055	-0.2	(D)	62	(D)	52	42	-2.1	61	[illegible]	11.7	704	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Salt Lake	180,651	272,043	4.2	1,604	1,443	-1.1	5,418	6,263	1.5	7,148	16,143	8.5	25,832	32,812	[illegible]	28,150	[illegible]	1.8	[illegible]	42,145	4.7
Tooele	11,514	10,959	-0.5	347	341	-0.2	136	70	-6.4	195	1,094	18.8	554	1,066	[illegible]	[illegible]	[illegible]	4.0	9,500	6,254	-3.1
Utah	37,804	59,393	4.6	3,192	2,708	-1.6	225	417	6.4	1,543	3,620	8.9	8,317	11,833	[illegible]	[illegible]	[illegible]	[illegible]	6,570	9,883	4.3
Washington	3,950	6,365	4.9	579	442	-2.7	(D)	28	(D)	195	444	8.6	197	503	10.4	46	[illegible]	[illegible]	961	1,365	[illegible]
Weber	44,667	49,011	0.9	1,335	1,147	-1.5	17	49	11.2	1,523	2,344	4.4	4,855	5,590	1.4	5,520	7,111	2.6	14,866	14,805	0.1
State Total	331,289	550,214	3.5	23,091	20,244	-1.3	10,330	14,825	3.7	13,676	31,814	8.8	50,216	73,997	4.0	19,081	[illegible]	[illegible]	104,014	127,463	2.1
U.S. Total (in millions)	82.5	97.8	1.7	4.6	4.2	-1.2	.6	.8	3.0	3.3	3.9	1.6	19.5	19.7	0.1	12.7	17.0	3.0	13.9	12.8	[illegible]

[1] Δ - average annual growth rate.

(D) - not shown to avoid disclosure of confidential information.

[2] Rate in doubt because of large number of data points withheld by disclosure rules.

Source: BEA, April, 1979.

all seven ROI counties in the state. Within the ROI, only a small number of jobs were in agriculture; this is consistent with the small shares in Utah and the United States as a whole for this industry. County shares in agriculture were highly variable in Utah, however, ranging from 0.5 percent in Salt Lake to 18.1 percent in Beaver County. In addition to Beaver, other rural counties have had relatively high agricultural employment shares.

The state had a negative rate of growth in agricultural employment from 1967-1977 (Table 3.2.3.1-7). This was consistent with national trends. Every county recorded a decline in agricultural employment, ranging from a low of 2.7 percent average annual growth over 1967-1977 in Washington County, to a high of 0.9 percent per annum in Beaver and Iron counties.

Mining has had a small role in the state and ROI county economies. It comprised only 2.6 percent of Utah's total employment in 1977. This share was relatively greater than that of Nevada, but well below that of the U.S. as a whole. Utah County, with 7.0 percent of 1977 employment in mining, had the largest share, while Washington County's 0.1 percent share was lowest. The state as a whole experienced a 3.7 percent average annual growth rate over 1967-1977 in mining. This was slightly above that of the nation as a whole. Rapid growth in mining employment was observed in Utah County, with the balance of the ROI counties growing less rapidly. Disclosure rules, however, have prevented a full accounting of county-specific mining employment.

Construction accounted for 5.8 percent of total state employment in 1977, well above the nation's 4.0 percent. Millard had the lowest share--1.2 percent--and Washington, the largest--10.0 percent. Salt Lake and Utah counties had shares approximating that of Utah as a whole. The most rapidly growing employment division in Utah was construction, with a 9.9 percent average annual growth rate. The U.S. growth rate, on the other hand, was only 1.6 percent per annum. Utah had an above average growth rate and Salt Lake County was very close to the state average. Only one county--Millard--showed a decline rather than growth in construction employment.

The share of manufacturing employment in Utah was 13.5 percent in 1977, well below the 20.1 percent share recorded for the nation. Iron County's share was the smallest--6.2 percent--while Juab had the largest--25.8 percent. Salt Lake County's share was 13.9 percent, nearly the same as that of Utah, and would be expected, given the dominance of the Salt Lake City metropolitan area within the state. Manufacturing employment in the state grew well, averaging 4.0 percent per annum over the 1967-1977 period. This rate of growth was much greater than the nation's growth rate of 0.1 percent for the same period. Iron, Millard, and Washington all exceeded the state's average growth in manufacturing, while the metropolitan counties of Salt Lake and Utah were close, experiencing 3.9 and 3.6 percent per annum, respectively over 1967-1977.

Jobs in services equalled about 81,000 in 1977, roughly 14.7 percent of total state employment. This percent share was less than one-half that of Nevada, but only slightly below the 17.4 percent of total U.S. employment recorded in the services industry. Of the ROI counties, only Salt Lake and Utah had service industry shares of their total employment above the state average. Other counties were predominantly rural and, as such, had little demand for a large, well-integrated service industry. Across Utah as a whole, the services division grew rapidly, at 4.9 percent per annum, over the 1967-1977 period. This growth was well above the U.S. growth rate of 3.0 percent. Millard grew the slowest at 0.6 percent and Utah County, the most rapid with an average annual rate of 5.5 percent. Iron, Juab, Washington, and Salt Lake counties all had above average growth rates in the service industry from 1967-1977.

Government had the dominant share of state employment in 1977. This industry's share of 23.2 percent translates into more than 125,000 jobs and was well above the 18.2 percent national average for government employment. Of the ROI counties in the state, however, only Iron County had a percent share figure above the 23.2 percent given above for the state as a whole. The government sector grew at a modest 2.1 percent average annual growth rate over the 1967-1977 period. Juab experienced negative growth in government employment over this longer period, while other counties came up to Salt Lake County's 4.2 percent per annum growth figure.

Income and Earnings (3.2.3.2)

Earnings trends basically follow employment. Since a detailed analysis of employment by industry has been given above, relatively little additional analysis will be given for earnings.

Because of the emphasis on services in Nevada, the state does not conform to the income and earnings characteristics of other states or the nation. In Nevada, income from the services industry was more than double the national average in 1977. In both Nevada and Utah, however, the economic sectors that grew the fastest between 1967 and 1977 were construction and manufacturing. Except for a decline in agriculture, real earnings from all sectors increased during the 10-year period.

Nevada

Total earnings in Nevada equalled $4,148.6 million in 1977, but were only about 0.4 percent of the U.S. total. Per capita income for Nevada averaged $7,[illegible] in 1977, about 14 percent more than the U.S. average of $7,026. Table 3.[illegible].2 details growth in earnings by major economic sector for Nevada as a whole [illegible] county. Table 3.2.3.2-2 presents per capita income and earnings shares [illegible] county for 1977.

Utah

Per capita income equalled $5,943 in 1977, well below that for either the nation as a whole or Nevada. The state as a whole had total 1977 earnings of $6,010.5 million, only 0.6 percent of the U.S. 1977 total, and slightly above the comparable figure for Nevada. Table 3.2.3.2-3 details growth in earnings by major industrial sector for Utah and selected counties over the period 1967-1977. Table 3.2.3.2-4 presents per capita income estimates and each industrial sector's share of total 1977 earnings for the state and selected counties.

Table 3.2.3.2-1. Earnings by economic sector, Nevada counties, 1967-1977. (In millions of 1977 dollars.)

COUNTY	TOTAL EARNINGS 1967	TOTAL EARNINGS 1977	TOTAL EARNINGS GROWTH RATE	AGRICULTURE 1967	AGRICULTURE 1977	AGRICULTURE GROWTH RATE	MINING 1967	MINING 1977	MINING GROWTH RATE	CONSTRUCTION 1967	CONSTRUCTION 1977	CONSTRUCTION GROWTH RATE
Carson City	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Churchill	[illegible]	[illegible]	[illegible]	[illegible]	4.63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Clark	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-13.2	[illegible]	[illegible]	[illegible]
Douglas	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]	D	[illegible]	[illegible]	[illegible]
Elko	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Esmeralda	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	D	D	D	D	D
Eureka	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.08	[illegible]	D	[illegible]	D
Humboldt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lander	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]	D	D	D	D
Lincoln	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	D	D
Lyon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]	[illegible]	[illegible]
Mineral	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nye	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.83	[illegible]	D	[illegible]	D
Pershing	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	D	[illegible]	[illegible]	[illegible]
Storey	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	D	D	D	D	D	D
Washoe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
White Pine	[illegible]	44.45	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
State	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
U.S.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COUNTY	MANUFACTURING 1967	MANUFACTURING 1977	MANUFACTURING GROWTH RATE	SERVICES 1967	SERVICES 1977	SERVICES GROWTH RATE	GOVERNMENT 1967	GOVERNMENT 1977	GOVERNMENT GROWTH RATE
Carson City	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Churchill	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Clark	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Douglas	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Elko	[illegible]	[illegible]	[illegible]	14.45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Esmeralda	D	D	D	D		D	[illegible]	[illegible]	[illegible]
Eureka	D	D	D	D	D	D	[illegible]	[illegible]	[illegible]
Humboldt	D	[illegible]	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lander	D	D	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lincoln	D	D	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lyon	[illegible]	[illegible]	[illegible]	D	[illegible]	D	[illegible]	[illegible]	[illegible]
Mineral	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Nye	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pershing	D	[illegible]	D	[illegible]	D	D	[illegible]	[illegible]	[illegible]
Storey	[illegible]	[illegible]	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Washoe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
White Pine	D	[illegible]	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
State	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

Source: Bureau of Economic Analysis, 1979.

Table 3.2.3.2-2. Per capita income and earnings shares by economic sector, Nevada counties, 1977.

[illegible]	[illegible]	[illegible]	[illegible]	AGRICULTURE SHARE %	MINING SHARE %	CONSTRUCTION SHARE %	MANUFACTURING SHARE %	SERVICE SHARE %	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	[illegible]	7.2	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4.7	[illegible]*	[illegible]	4.1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]*	8.7	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	8.1	7.5	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.2	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	D	ND		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42.4	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	12.4	[illegible]*	5.4	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]*	[illegible]*	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	D	[illegible]*	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.4	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]*	12.6	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		2.2	[illegible]	[illegible]	26.2	[illegible]	[illegible]

[illegible]

Table 3.2.3.2-3. Earnings by economic sector in selected Utah counties, 1967-1977. (In millions of 1977 dollars.)

COUNTY	TOTAL EARNINGS			AGRICULTURE			MINING			CONSTRUCTION		
	1967	1977	GROWTH RATE	1967	1977	GROWTH RATE	1967	1977	GROWTH RATE	1967	1977	GROWTH RATE
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COUNTY	MANUFACTURING			SERVICES			GOVERNMENT		
	1967	1977	GROWTH RATE	1967	1977	GROWTH RATE	1967	1977	GROWTH RATE
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 3.2.3.2-4. Per capita income and earnings shares by economic sector, selected Utah counties, 1977.

UNIT	1977 PER CAPITA INCOME	TOTAL 1977 EARNINGS (1,000s)	AGRI-CUL-TURE SHARE %	MIN-ING SHARE %	CON-STRUC-TION SHARE %	MANU-FACT-URING SHARE %	SERV-ICES SHARE %	GOVERN-MENT SHARE %
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.8	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.0
[illegible]	[illegible]	54,175	[illegible]	[illegible]	[illegible]	6.6	11.3	29.4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36.1	7.9	[illegible]
Millard	[illegible]	22,246	[illegible]	[illegible]	[illegible]	6.5	[illegible]	[illegible]
Salt Lake	[illegible]	[illegible]	[illegible]	[illegible]	4.7	15.4	[illegible]	14.7
Tooele	[illegible]	[illegible]	[illegible]	[illegible]	14.8	11.6	[illegible]	[illegible]
Utah	[illegible]	[illegible]	[illegible]	[illegible]	9.2	[illegible]	[illegible]	[illegible]
Washington	[illegible]	[illegible]	4.7	[illegible]	[illegible]	16.8	14.5	21.6
Weber	[illegible]	492,894	[illegible]	[illegible]	7.5	14.0	14.8	[illegible]
State	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14.2	[illegible]
United States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26.2	[illegible]	[illegible]

[illegible]

Public Finance (3.2.3.3)

The major sources of revenue for Nevada are taxes from sales and personal use and gaming, which combined, account for over three-quarters of the state's general fund revenues. In Utah, sales and income taxes account for nearly three-fourths of the total revenues. For both states, the largest expenditure is for education, followed by social services.

Population and Communities (3.2.3.4)

Recent population trend data for Nevada and Utah, shown in Table 3.2.3.4-1, indicate 33 and 22 percent population growth rate for Nevada and Utah, respectively, for the decade between 1965 and 1975. The increase in Nevada has been due primarily to in-migrants from other states and has been concentrated mainly in Clark and Washoe counties, which contain the cities of Las Vegas and Reno. Rural areas, on the other hand, have attracted few new settlers. Utah population increased as well, but primarily from an excess of births over deaths rather than from in-migration.

Over 80 percent of the total Nevada population is classed as urban, with 56 percent of the state's total in Las Vegas and 24 percent in Reno. Of the 21.1 percent increase that took place in the state between 1960 and 1970, 15.7 percent was through net in-migration and 5.3 percent by natural increase. Nevada's population is projected to more than double by 1990, but the number of households will increase more rapidly than the population.

Although Utah registered a 2.6 percent annual rate of growth over the 1970-1977 period (well above the U.S. average), it ranked behind growth in Nevada, Arizona, Wyoming, and Idaho. More than half of the state's population reside in Salt Lake and Utah counties. The annual growth rate over the period 1960-1970 was somewhat lower (1.7 percent) than that experienced between 1970 and 1975. Of the 13.9 percent total population increase that occurred between 1970 and 1975, 10.3 percent was from natural increase, while only 3.6 percent was due to net in-migration.

Transportation (3.2.3.

Roads (3.2.3.5.1)

The area is served by U.S. Highways 6, 50, and 93 and State Routes 2, 7, and 25 and 8A, 21, 25, 38, 46, and 51 in Nevada; and 21 and 56 and 257 in Utah. Interstate Routes 70, 80, and 15 provide access. These highways are shown on Figure 3.2.3.5-1, along with the annual average daily traffic for 1979 in Nevada and [illegible] in Utah. These routes connect small cities and communities, none of which has [illegible] population over 1,000. Communites with populations over 1,000 are identified in [illegible] 3.2.3.5-1.

[illegible] federal routes are primarily two-lane paved roads. Numerous lesser [illegible] are graded, unsurfaced roadways, or unimproved trails created by [illegible]

[illegible] are very light and the roadway network accommodates this [illegible].

Table 3.2.3.4-1. Population and employment in Nevada/Utah by year 1965-1975.

YEAR	NEVADA		UTAH	
	EMPLOYMENT	POPULATION	EMPLOYMENT	POPULATION
1965		444,000		991,000
1966		446,000		1,009,000
1967	[illegible]	449,000	391,289	1,019,000
1968	214,657	464,000	398,641	1,029,000
1969	[illegible]	480,000	412,032	1,047,000
1970	243,764	493,000	419,071	1,066,000
1971	252,706	511,000	431,959	1,094,000
1972	265,799	532,800	451,064	1,127,400
1973	281,526	551,161	475,518	1,150,230
1974	291,620	574,055	492,056	1,178,697
1975	296,843	592,007	497,482	1,205,923

2160-1

Source: U.S. Department of Commerce, Bureau of Economic Analysis, and U.S. Department of Labor.

The capacity of most segments of the existing highway system is relatively high, since the roads are generally in good condition, with good alignment and moderate grades. However, through mountain passes, highway alignment and grade are influenced by the topography causing a corresponding reduction in capacity. Critical sections with restricted capacity are shown on Figure 3.2.3.5-1 and are listed in Table 3.2.3.5-1.

Load-carrying limits in both Nevada and Utah are based on the number of axles. Load limits are 20,000 lb for a single axle and 34,000 lb for a tandom axle in Nevada, and 18,000 lb and 34,000 lb respectively in Utah. Length, height, and size limits are 70 ft, 14 ft, and 8 ft respectively in Nevada, and 65 ft, 14 ft, and 8 ft in Utah.

Railroads (3.2.3.5.2)

The Nevada Northern Railroad has its southern terminus in Ruth, northwest of Ely. It runs north and south, providing rail service to Ely, McGill, Warm Springs, and Currie and intersects with the Western Pacific Railroad at Shafter, Nevada. Western Pacific runs east and west across Nevada and Utah. A Union Pacific Railroad line connects Las Vegas with Salt Lake City and services Caliente, Beryl, Lund, Milford, and Delta, among other communities.

Air Traffic (3.2.3.5.3)

Major airline service is provided through the airports at Las Vegas and Reno, Nevada, and Salt Lake City, Utah. There are a number of small public and private airstrips and a limited amount of commercial traffic in Ely, Nevada, and Delta and Cedar City, Utah.

Energy (3.2.3.6)

Fuel Supply

There are few pipelines for crude oil, product oil, or natural gas which pass through the deployment region in Nevada and Utah. The existing and proposed pipelines have been plotted from information from the energy companies and the federal agencies and is presented in Figure 3.2.3.6-1. Among the currently proposed natural gas lines are the Rocky Mountain Pipeline that may pass near Ely and the Pacific Gas Transmission proposal for a 30-inch high pressure gas transmission line from Wyoming through Cedar City and Las Vegas. Projected fuel consumptions are presented in Table 3.2.3.6-1. In general, liquid fuels are trucked to distribution centers and distributed locally.

The Nevada/Utah region has numerous geothermal resources which may be tapped for alternative energy systems.

Electric Power Supply

The Nevada/Utah study area is serviced by Regions 27, 28, and 30 of the Western Systems Coordinating Council (WSCC). Projected peak demands without M-X and available resources are presented for winter and summer conditions in Figures 3.2.3.6-2 and 3.2.3.6-3 respectively. Capacity will be increased as a result

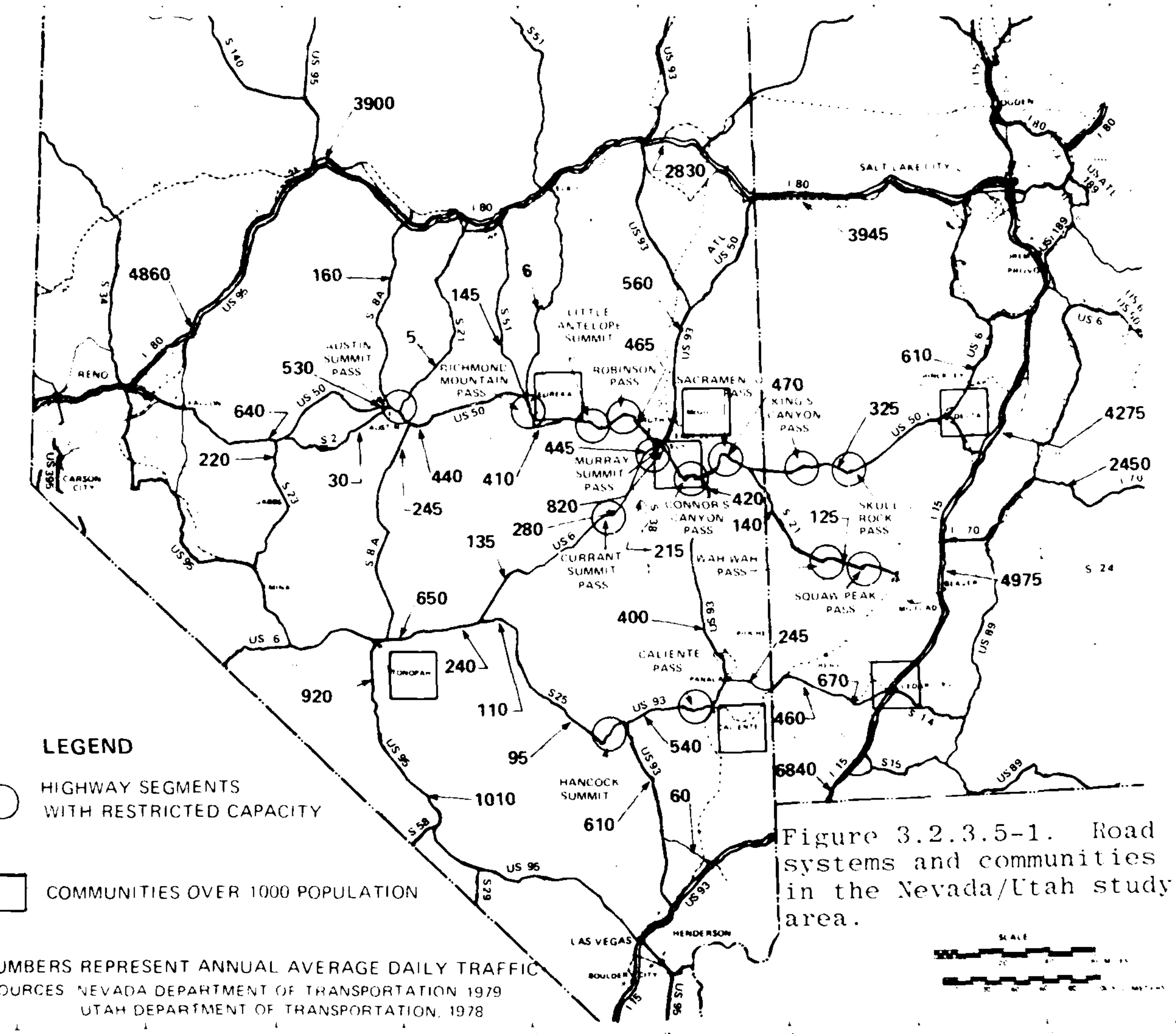
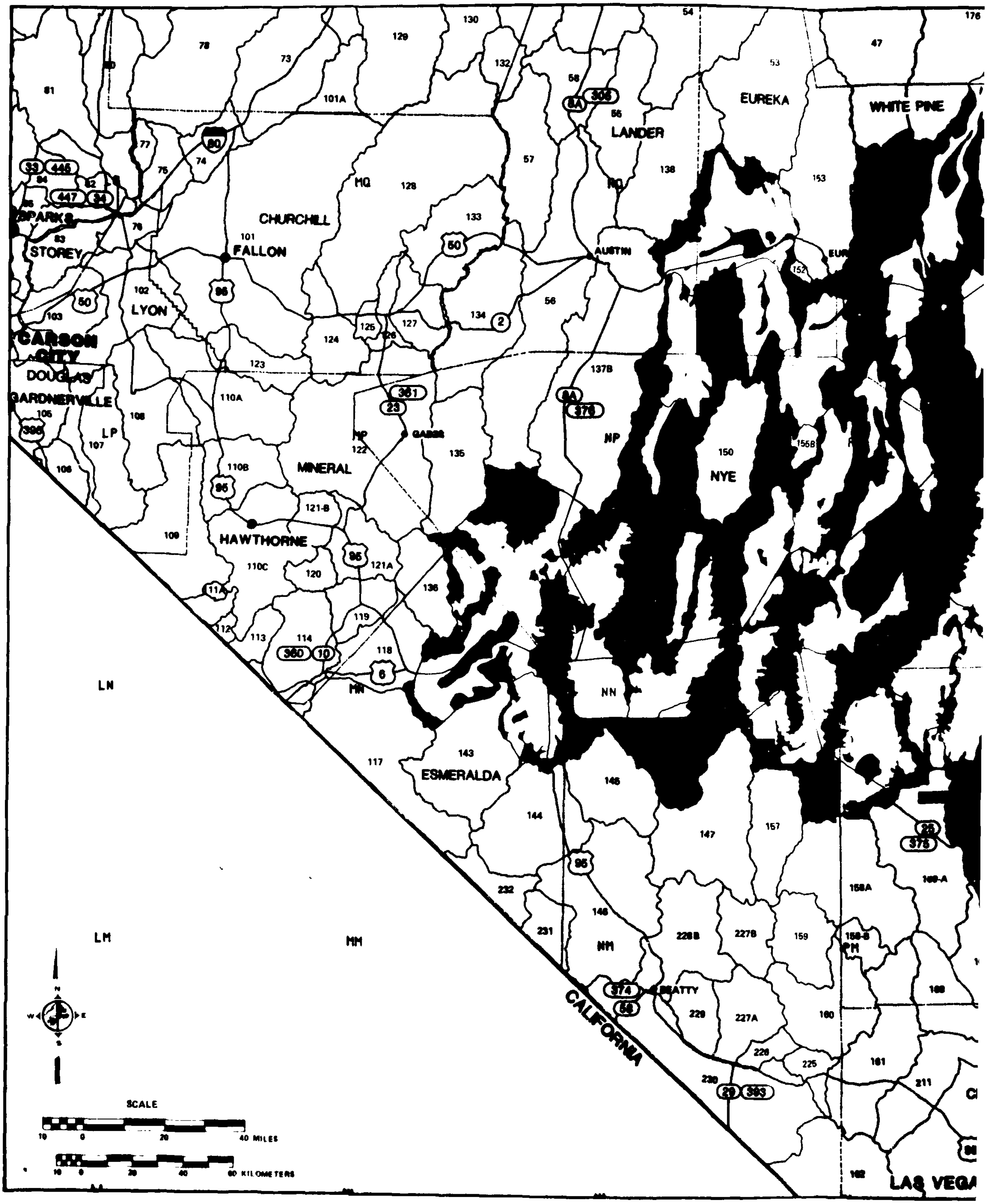


Figure 3.2.3.5-1. Road systems and communities in the Nevada/Utah study area.

2502 A

Table 3.2.3.5-1. Locations of severe grades and alignments in the Nevada/Utah study area.

[illegible]	[illegible]	[illegible]	PERCENT OF MAXIMUM GRADE	LENGTH [illegible]	[illegible]	[illegible]
[illegible]	[illegible] mi. SW of Delta	U.S. [illegible]	[illegible]	[illegible]	Fair	[illegible]
[illegible]	[illegible] mi. SW of Delta	U.S. [illegible]	[illegible]	[illegible]	Moderate [illegible]	[illegible]
[illegible]	[illegible] mi. East of Ely	U.S. [illegible]	[illegible]	[illegible]	Moderate	[illegible]
[illegible]	[illegible] mi. East of Ely	U.S. [illegible]	[illegible]	[illegible]	Moderate	
[illegible]	[illegible] mi. West of Ely	U.S. [illegible]	[illegible]		Moderate	[illegible]
[illegible]	[illegible] mi. West of Ely	U.S. [illegible]	[illegible]		Moderate [illegible]	[illegible]
[illegible]	[illegible] mi. East of Eureka	U.S. [illegible]	[illegible]	[illegible]	Moderate	[illegible]
[illegible]	Austin [illegible] mi. East of Austin	U.S. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] mi. West of Milford	Utah [illegible]	[illegible]	[illegible]	Moderate	
[illegible]	[illegible] mi. West of Milford	Utah [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] mi. West of [illegible]	U.S. [illegible]	[illegible]	[illegible]	Moderate	[illegible]
[illegible]	[illegible] mi. West of Crystal Springs	Nevada [illegible]	[illegible]	[illegible]	Fair-Moderate	[illegible]
[illegible]	[illegible] mi. NE of [illegible] Ranch	U.S. [illegible]	[illegible]	[illegible]	Fair	[illegible]
[illegible]	[illegible] mi. [illegible] of Ely	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]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FALLON
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BEATTY
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KILOMETERS

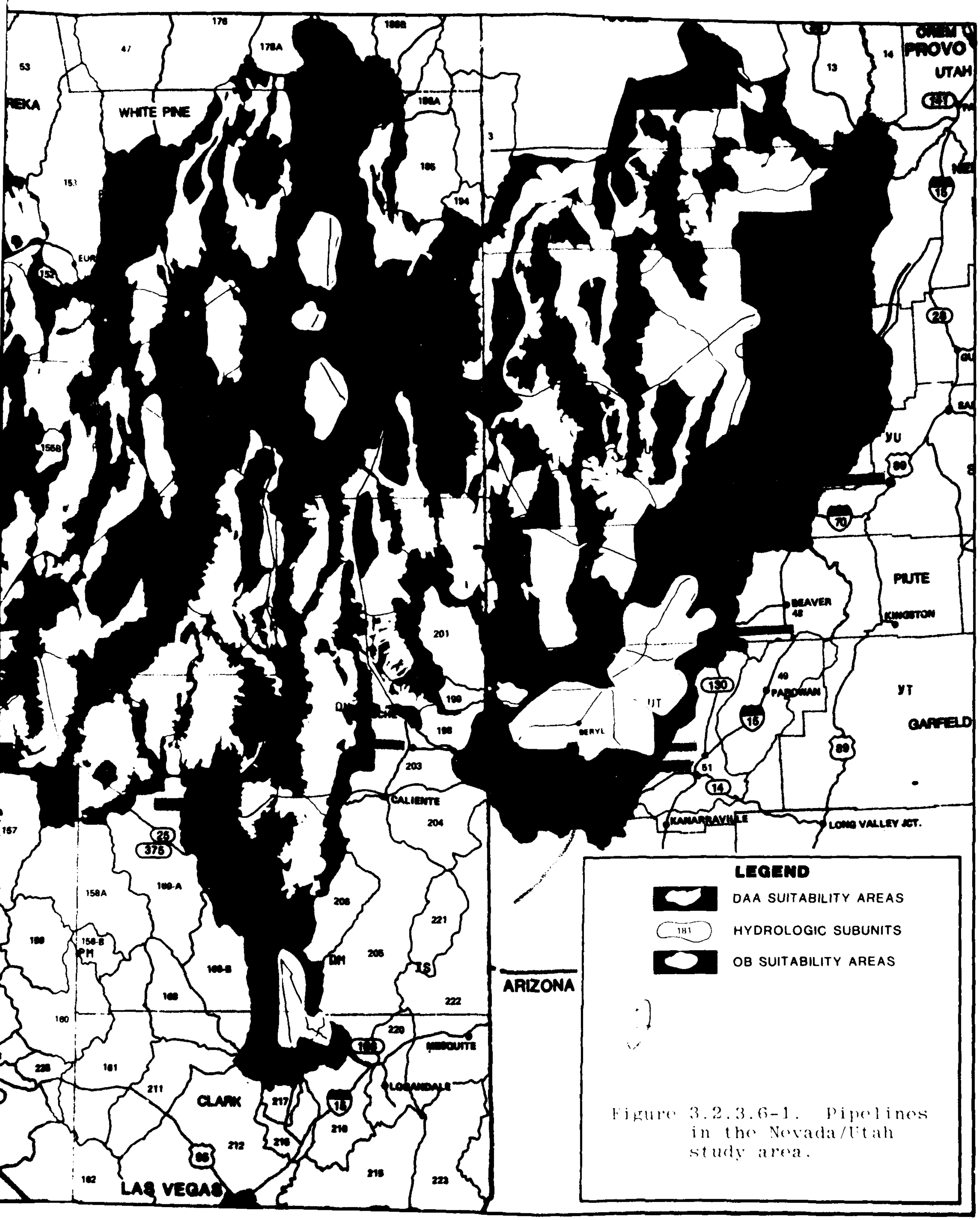

Figure 3.2.3.6-1. Pipelines in the Nevada/Utah study area.

3222-D

Table 3.2.3.6-1. Fuel consumption projections.

FUEL	NEVADA			UTAH		
	1978	1985	1990	1978	1985	1990
Total Petroleum (thousands of barrels)	29,320	23,890	24,140	40,210	32,770	33,170
Natural Gas (Dry) (millions of cubic ft)	64,310	61,280	63,360	118,510	112,590	117,330
Total Fuel Oil (thousands of barrels)	3,830	3,080	3,230	9,020	7,270	7,770
Diesel Fuel (thousands of barrels)	1,[illegible]	1,210	1,240	2,130	1,720	1,830
Heating Fuel (thousands of barrels)	480	380	410	1,380	1,110	1,190
Gasoline (thousands of barrels)	11,700	9,800	9,320	17,480	14,650	13,930
Jet Fuel (thousands of barrels)	6,650	6,650	7,260	1,900	1,900	2,070

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1 Barrel = 42 Gallons

Actual consumptions for 1978. Same proportions assumed of total fuel oils for 1985 and 1990 projections.

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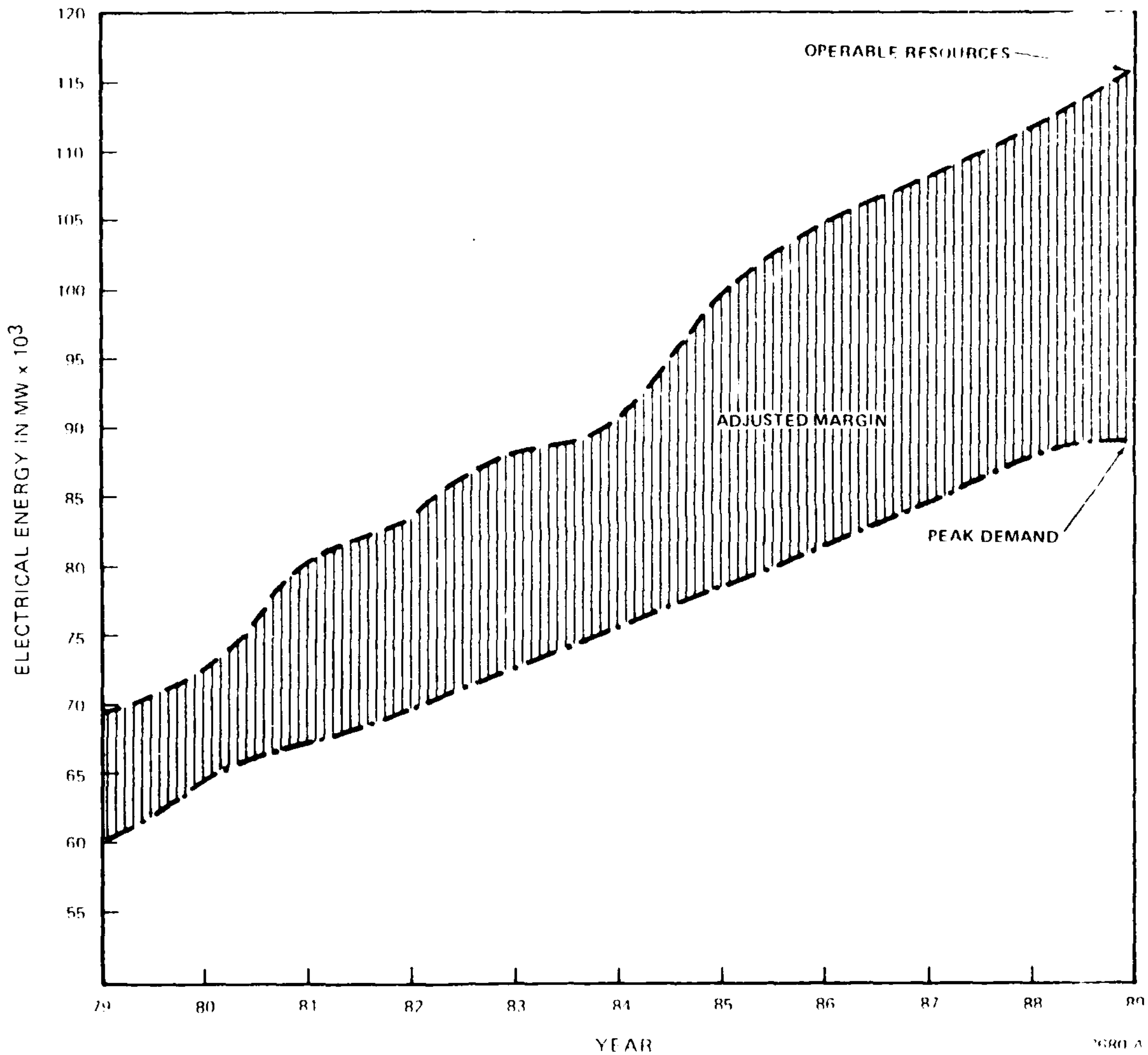


Figure 3.2.3.6-2. Western Systems Coordinating Council (WSCC), regions 25, 27, 28, and 30, projected peak demands and resources (winter conditions, Nevada/Utah).

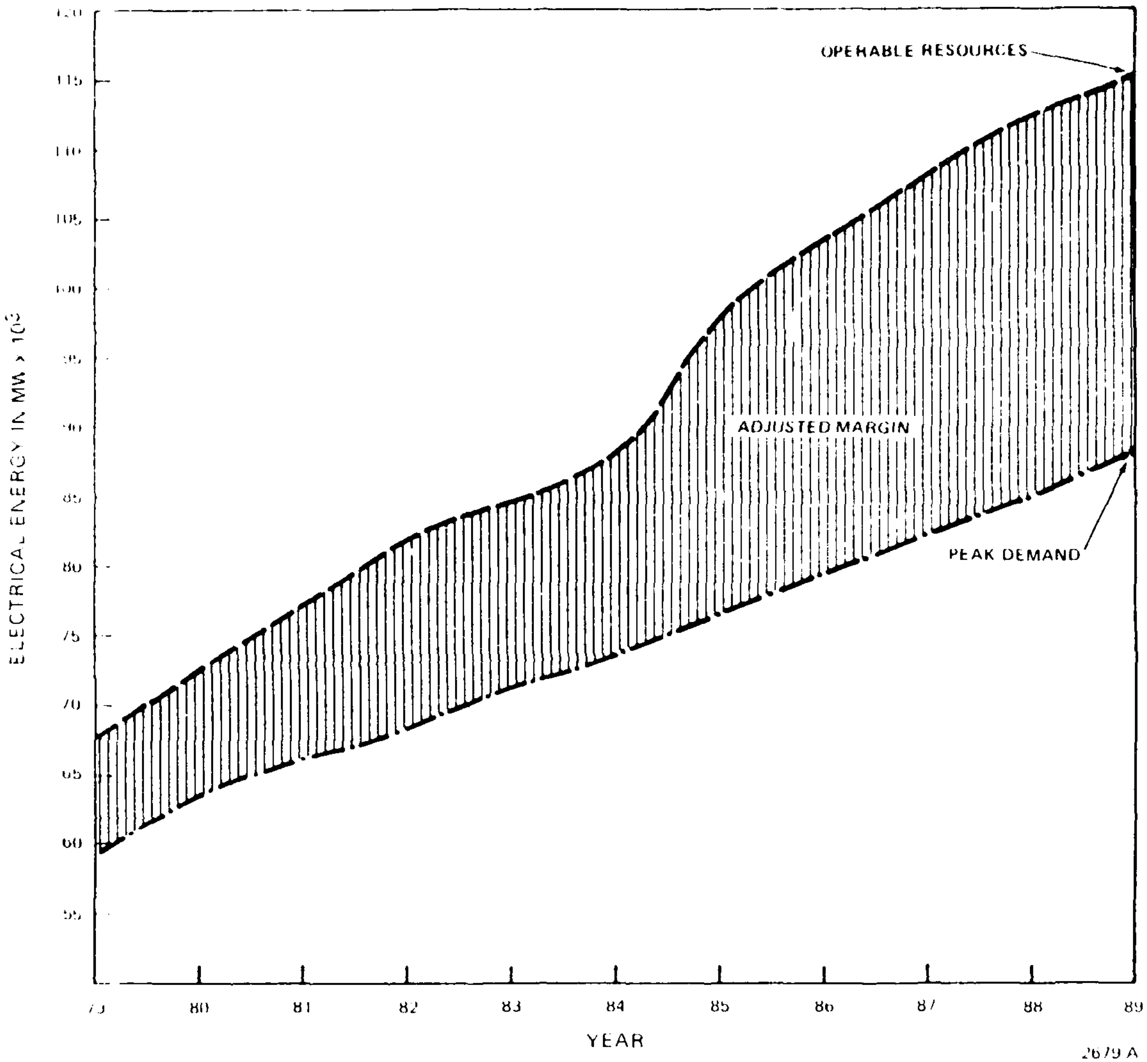


Figure 3.2.3.6-3. Western Systems Coordinating Council (WSCC), regions 25, 27, 28, and 30, projected peak demands and resources (summer conditions, Nevada/Utah).

of the construction of facilities such as the Intermountain Power Project, the Harry Allen power plant and the White Pine power project.

The existing and proposed transmission lines are shown in Figure 3.2.3.6-4 for the Nevada/Utah region. As can be seen, in the vicinity of the proposed MX deployment area there are not many transmission lines.

Land Ownership (3.2.3.7)

Federal Land, Nevada/Utah

Several federal agencies administer land in the Nevada/Utah study area counties (the acreage is given by county in Table 3.2.3.7-1). The Bureau of Land Management (BLM) of the Department of the Interior, administers the largest portion of these federal lands; the acreage administered by the BLM in Nevada/Utah study area counties is included in Table 3.2.3.7-2.

Private Land, Nevada/Utah

In most cases, existing communities are located in areas where adequate private land exists to support additional development. In some areas, however, extensive growth and development of communities would be restricted if public land was not available (Table 3.2.3.7-2 and Figure 3.2.3.7-1).

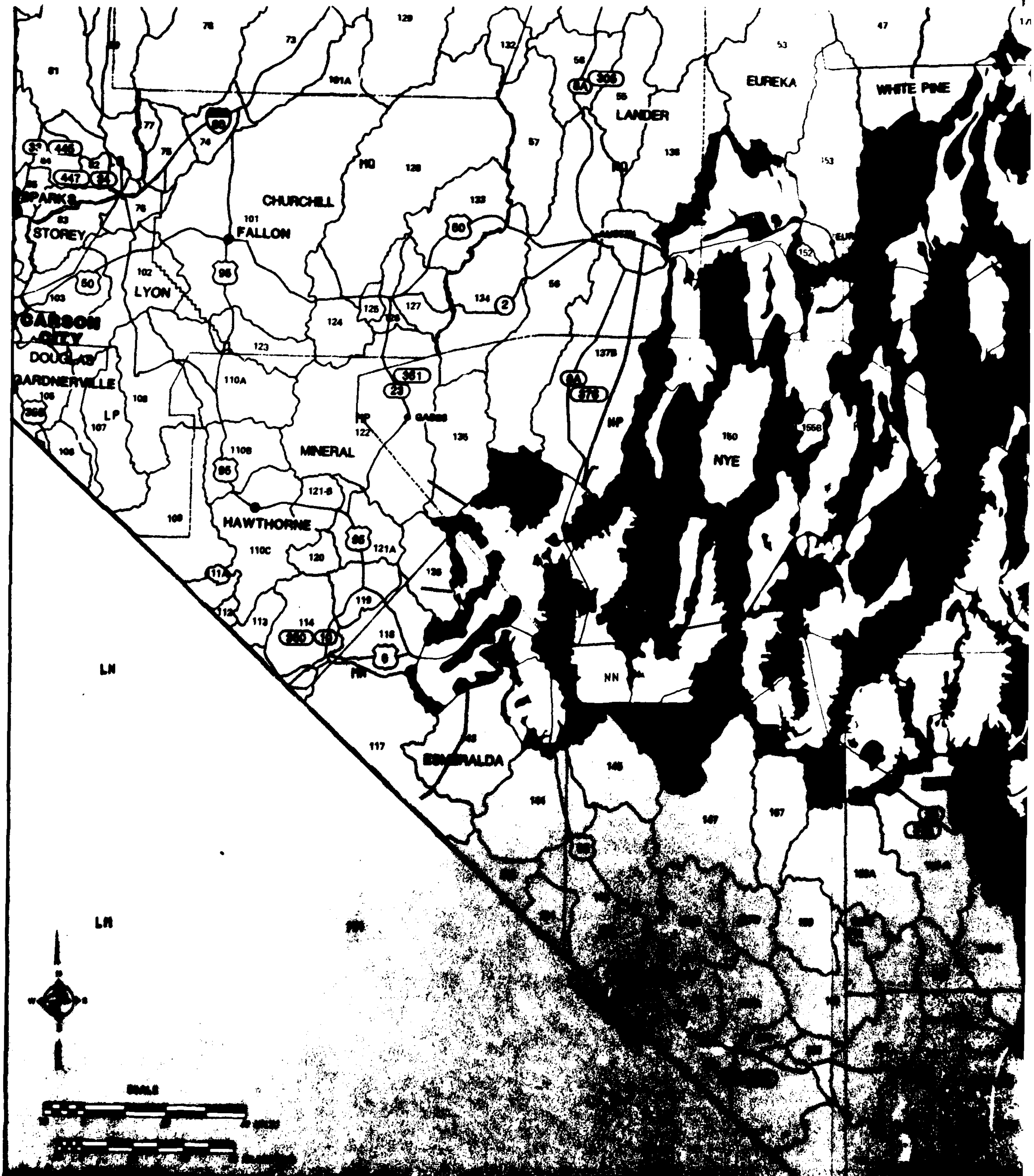
State Land, Nevada/Utah

Utah and Nevada differ in the amount of land that is state land (Table 3.2.3.7-2 and Figure 3.2.3.7-2). Utah, as a condition of statehood, was granted four sections of federal land from each township to assist in the support of the schools of the state. On some of its state-owned lands, Utah has a system of parks and monuments, etc., but the majority is still vacant and generally undeveloped. Nevada, on the other hand, has comparably little state-owned land, and most of that is developed for various purposes such as state parks and historic sites.

Land Use (3.2.3.8)

Nevada and Utah economies have planning and zoning ordinances that protect agricultural land from urban development. Nevada's agricultural development is geared toward the livestock industry; Utah's is more diversified. The numbers of farms and farming acreage are listed in Table 3.2.3.8-1. Table 3.2.3.8-2 shows trends in farming in Nevada and Utah for the past 30 years, and the market value of crops, hay, and livestock and livestock products for 1974 is shown in Table 3.2.3.8-3.

Acreages for total cropland, harvested cropland, cropland used as pasture, and irrigated land are shown in Table 3.2.3.8-4. Figure 3.2.3.8-1 illustrates the relationship of croplands to geotechnically suitable land.



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GARDNERVILLE
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ESMERALDA
LANDER
EUREKA
WHITE PINE
NYE

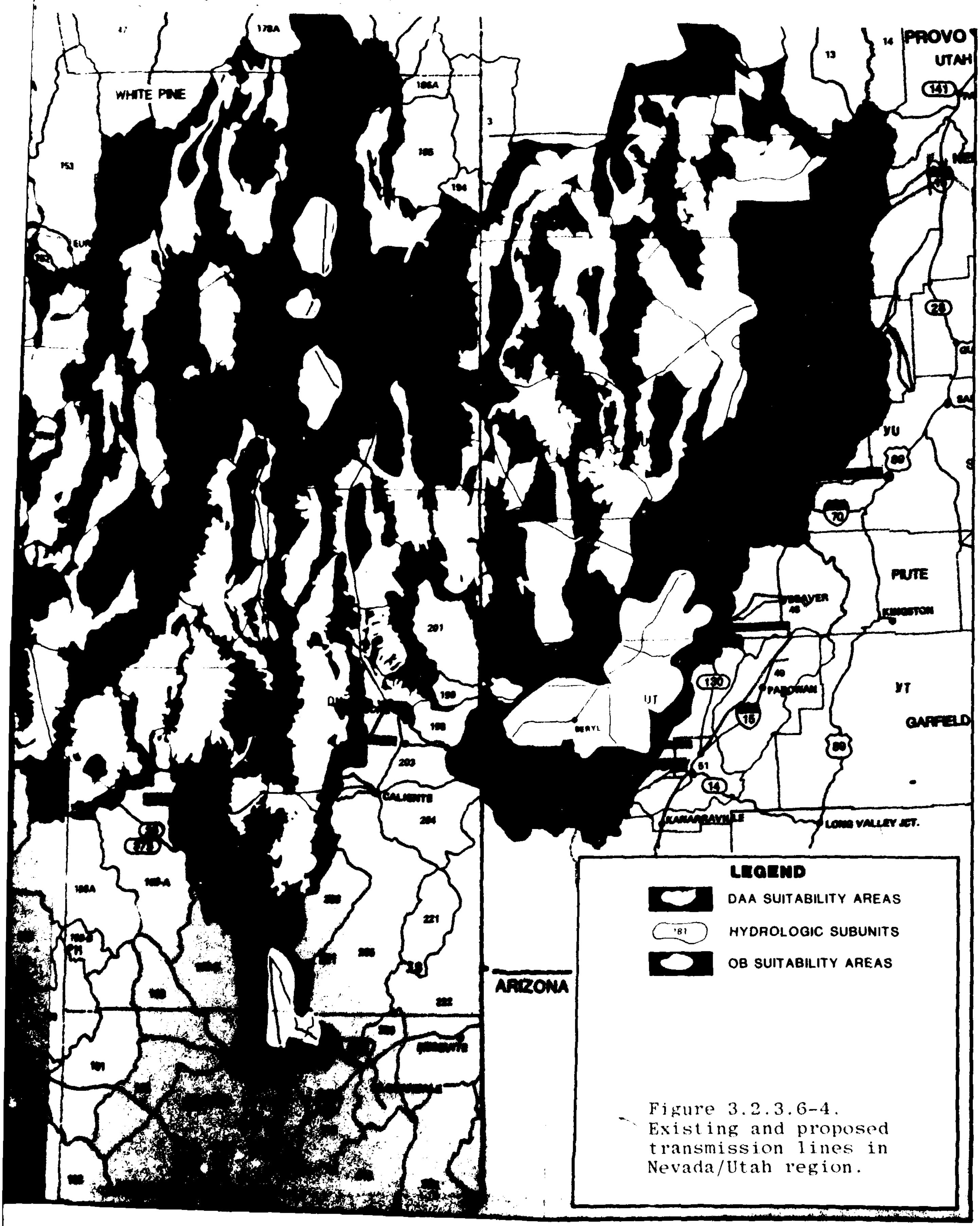

Figure 3.2.3.6-4. Existing and proposed transmission lines in Nevada/Utah region.

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Table 3.2.3.7-1. Federally administered acreage by county in the Nevada/Utah study area, excluding BLM administered land.

COUNTY	FOREST SERVICE	NATIONAL PARKS	WATER AND POWER RESOURCES SERVICE[a]	FISH WILDLIFE SERVICE	INDIAN RESERVATION	DEPARTMENT OF DEFENSE
Nevada						
Clark	[illegible]	49[illegible]	[illegible]	501,80[illegible]	4.4	33[illegible],4[illegible]
Esmeralda	4[illegible]	[illegible]	—	—	—	—
Eureka	[illegible]	—	—	—	2[illegible]	—
Lander	[illegible]	—	—	—	2[illegible]	—
Lincoln	[illegible]	—	—	[illegible],50[illegible]	—	[illegible]
Nye	[illegible]	92[illegible]	—	—	[illegible]	[illegible]
Pershing	—	—	[illegible]	—	2[illegible]	—
White Pine	[illegible]	—	—	[illegible]	[illegible]	—
TOTAL	[illegible]	[illegible]	[illegible]	[illegible],80	85,[illegible]	[illegible],241,4[illegible]
Utah						
Beaver	[illegible]	—	—	[illegible]	—	—
Iron	24[illegible]	[illegible]	—	—	—	—
Juab	[illegible]	—	[illegible]	[illegible],40	[illegible]	—
Millard	[illegible]	—	—	[illegible],50[illegible]	—	—
Tooele	[illegible]	—	—	—	—	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible],9[illegible]	[illegible]	[illegible]
Study Area Total	4[illegible]	[illegible]	[illegible]	[illegible]	12[illegible]	4,[illegible]

2566-1

[a] Formerly Bureau of Reclamation.

Source: Department of Interior, 19[illegible]; University of Utah, 1976.

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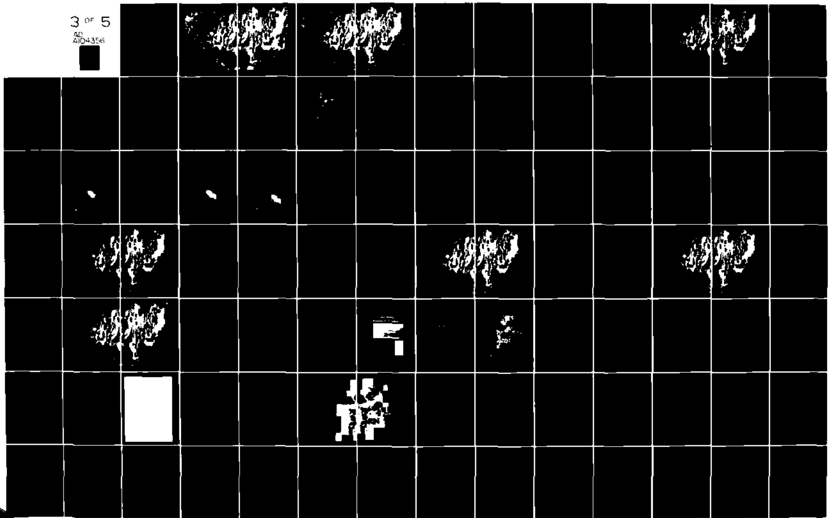

Table 3.2.3.7-2. State, private, and BLM-administered lands in the Nevada/Utah study area counties, in thousands of acres.

STATE COUNTY	TOTAL LAND	BLM ADMINISTERED LAND	PERCENT OF TOTAL	PRIVATELY OWNED LANDS	PERCENT OF TOTAL	STATE LAND	PERCENT OF TOTAL
Nevada							
Clark	[illegible]	[illegible],461	67	469.4	[illegible]	46.1	[illegible]
Esmeralda	2,285	2,121	92	162.6	7.1	—	—
Eureka	2,688	2,187	81	486.2	18.1	—	—
Lander	[illegible]	[illegible]	91	289.7	8.1	[illegible]	—
Lincoln	[illegible],816	6,580	96	219.4	3.2	6.7	0.1
Nye	[illegible]	[illegible],711	92	822.7	7.1	[illegible]	[illegible]
Pershing	[illegible]	2,910	76	917.1	23.7	—	—
White Pine	[illegible]	4,365	77	391.1	6.9	1.6	—
Utah							
Beaver	1,654	[illegible]	70	272.4	16.5	145.[illegible]	8.8
Iron	2,111	974	46	753.1	35.7	131.1[illegible]	6.2
Juab	2,164	1,408	65	393.9	18.[illegible]	179.80	8.1
Millard	4,251	[illegible]	70	474.0	11.1	401.71	9.5
Tooele	4,42[illegible]	4,083	92	83.4	1.8	256.27	5.7
Total	5[illegible],309	45,275	82.1	5,756.[illegible]	10.[illegible]	1,181.[illegible]	2.1

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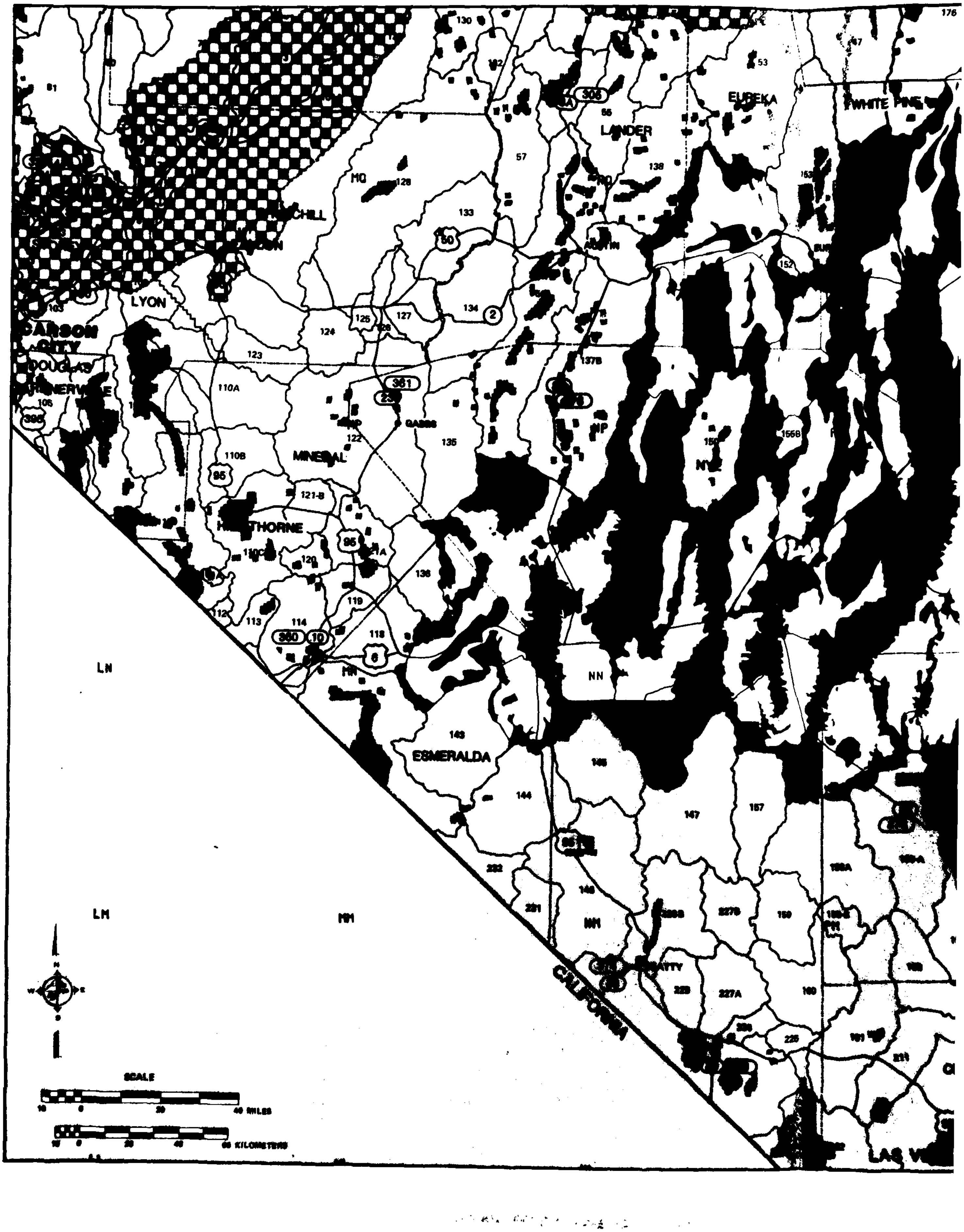
NOTE: Does not include lands administered by federal agencies other than the BLM.

Source: Nevada Governor's Office of Planning Coordination, January 1976, and University of Utah, 1978.



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LANDER
EUREKA
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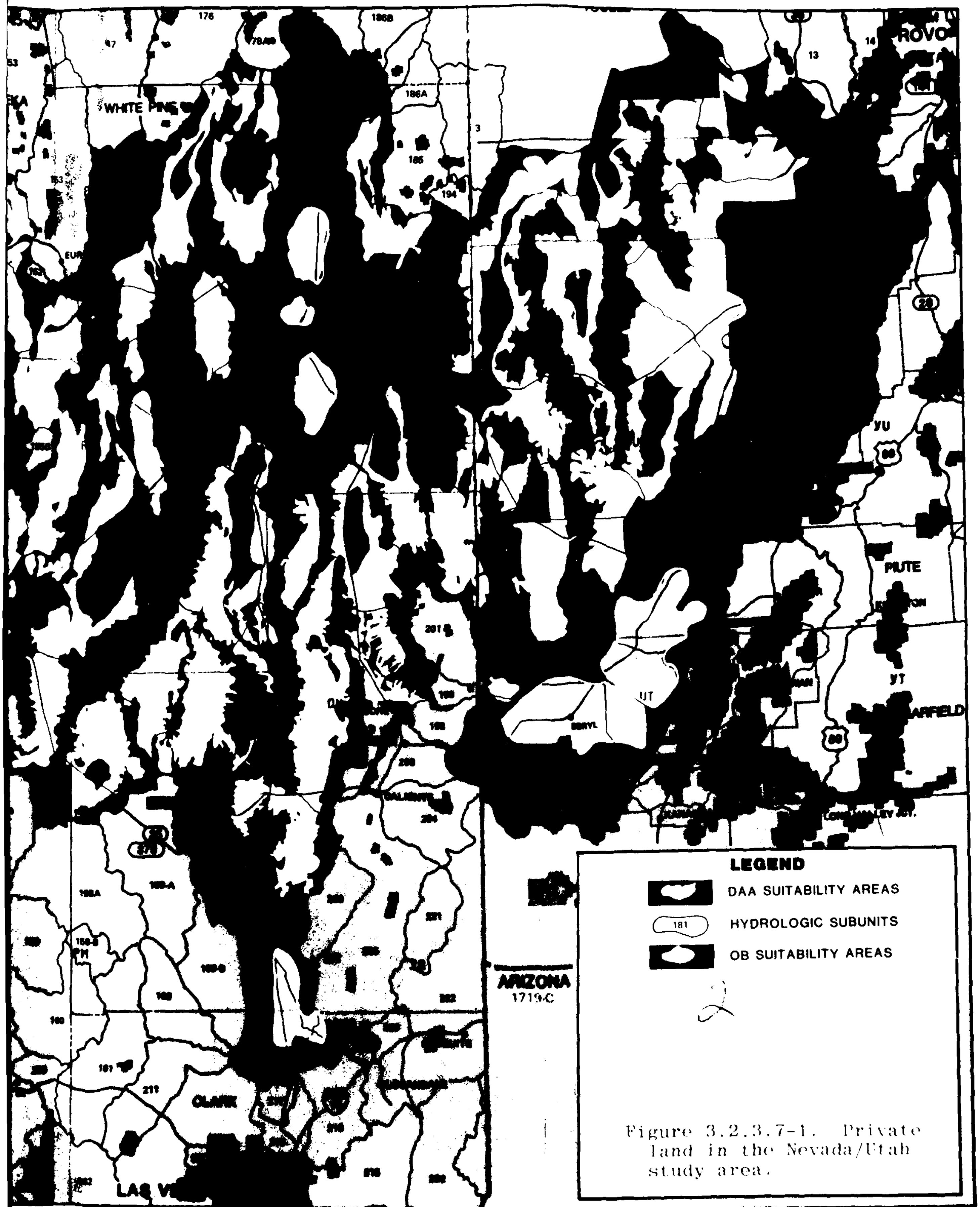

Figure 3.2.3.7-1. Private land in the Nevada/Utah study area.

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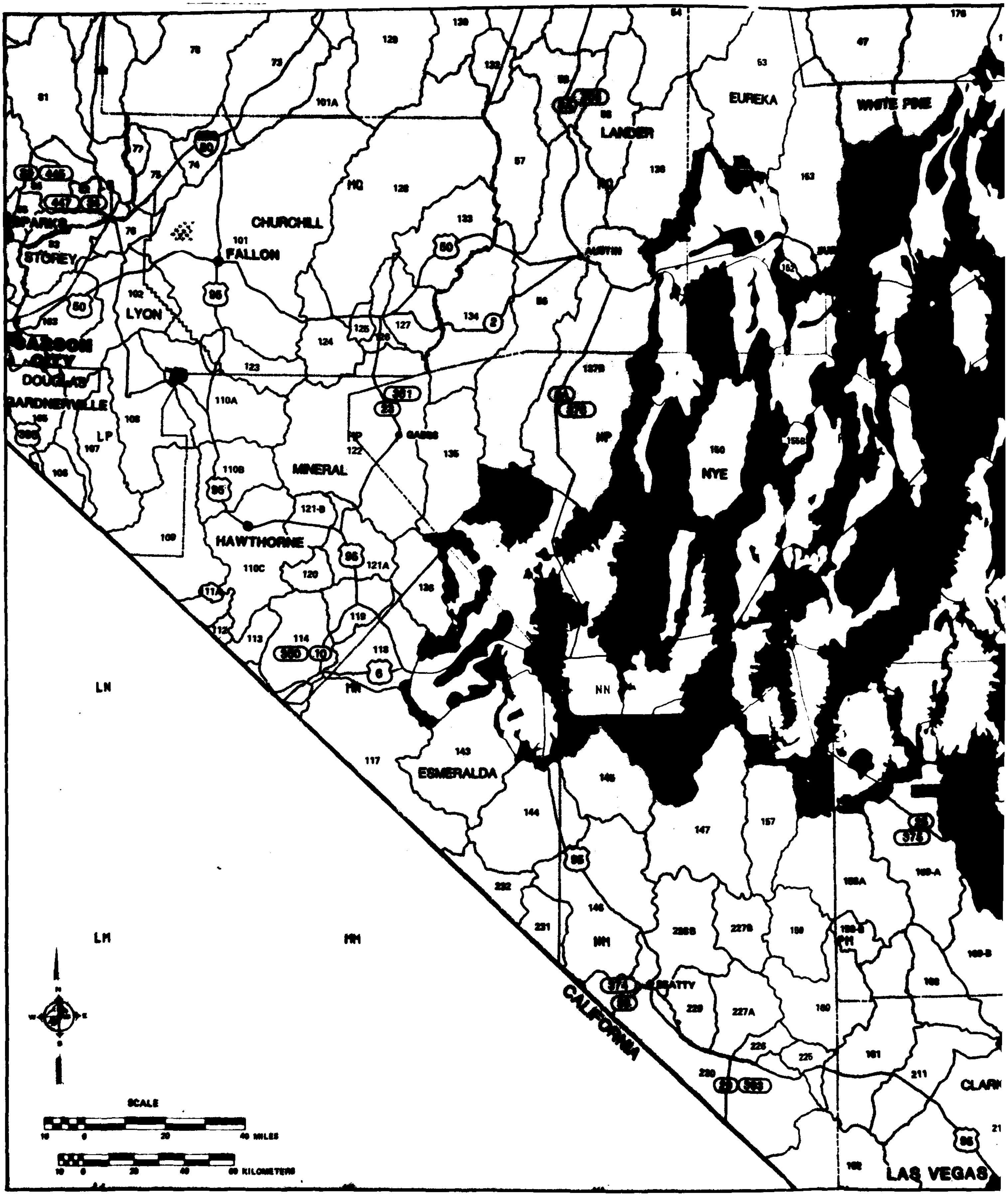
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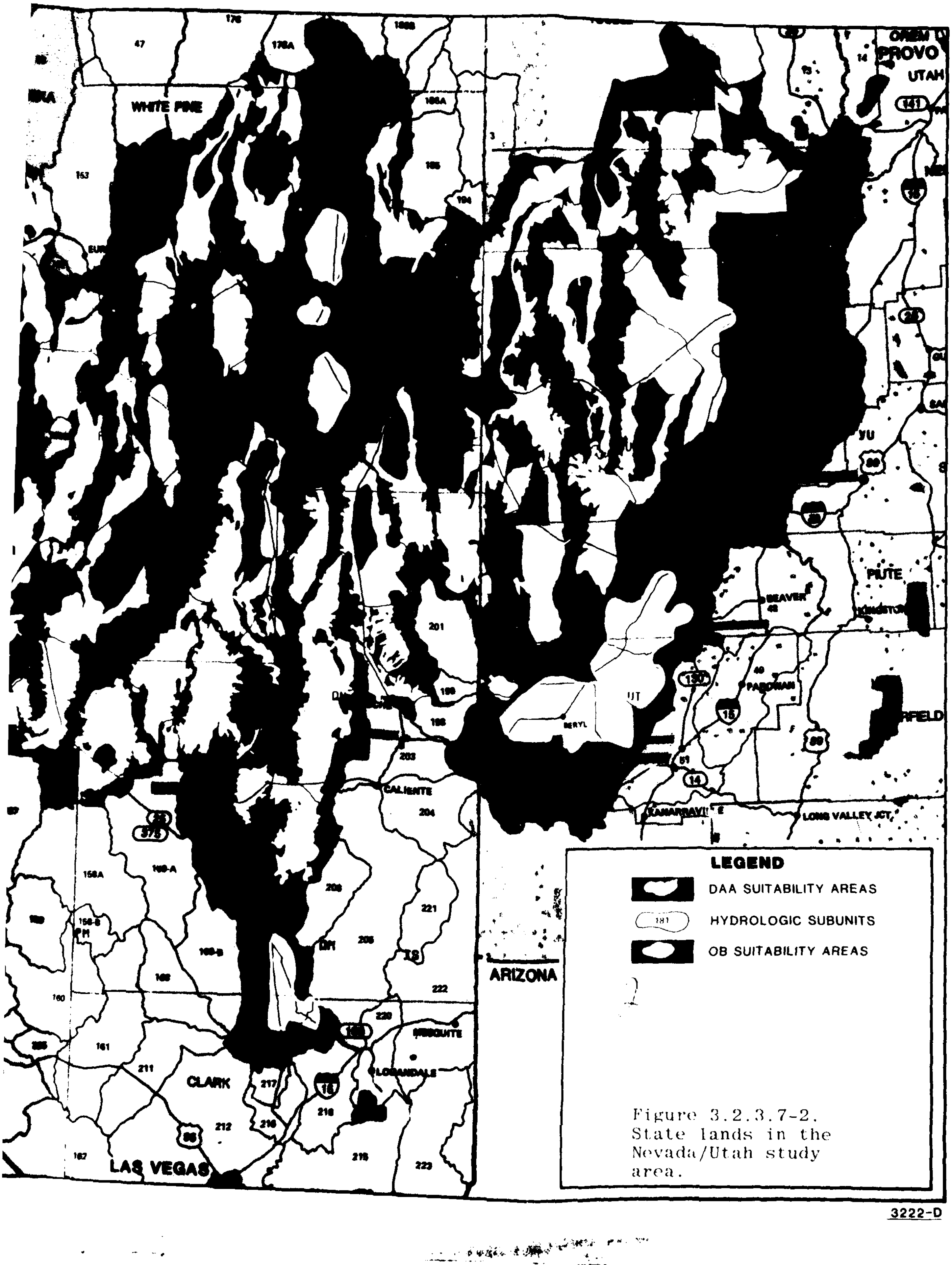


Figure 3.2.3.7-2. State lands in the Nevada/Utah study area.

3222-D

Table 3.2.3.8-1. Farms and farmland in Nevada/Utah study area counties, 1977.

COUNTY	NUMBER OF FARMS	AVERAGE SIZE OF FARMS (ACRES)	TOTAL ACREAGE IN FARMLAND[1]	FARMLAND AS PROPORTION OF ALL COUNTY LAND (PERCENTAGE)	COUNTY FARMLAND AS PROPORTION OF STATE FARMLAND (PERCENTAGE)
Nevada					
Clark	147	534	78,252	1.6	[illegible]
Esmeralda	26	[illegible]	1,510,187	109.9[2]	[illegible]
Eureka	62	4,281	265,417	9.9	[illegible]
Lander	58	[illegible]	[illegible]	17.4	[illegible]
Lincoln	75	778	58,320	.9	[illegible]
Nye	[illegible]	4,588	445,051	3.8	[illegible]
Pershing	[illegible]	6,670	646,954	16.8	[illegible]
White Pine	100	2,312	231,246	4.1	[illegible]
State Total	662	7,343	4,861,073	—	[illegible]
Utah					
Beaver	183	822	150,368	9.1	1.4
Iron	337	1,365	459,917	21.8	4.3
Juab	201	780	156,760	7.2	1.4
Millard	652	823	536,409	12.3	5.0
Tooele	[illegible]	1,876	429,516	9.7	4.0
State Total	1,602	1,082	[illegible]	—	16.2
Bi-State Total	2,264	[illegible]	[illegible]	—	[illegible]

DDDD-1

[1] Include all cropland, pasture and grazing land, except that on open range under government permit.

[2] Tabulated as being in the operator's principal county which is defined as the one with the largest value of agricultural products was produced. This is where the operator reported all or the largest portion of his total land. As a result of this procedure, Esmeralda County exceeds 100 percent.

Source: Dept. of Commerce (1977).

Table 3.2.3.8-2. Trends in farming in Nevada/Utah, 1950-1974.

YEAR	NUMBER OF FARMS	ACREAGE IN FARMS	IRRIGATED ACREAGE IN FARMS	HARVESTED ACREAGE IN FARMS
Nevada				
1950	3,110	7,064,000	727,000	421,000
1954	2,857	8,231,000	567,000	360,000
1959	2,354	10,943,000	543,000	338,000
1964	2,156	10,482,000	824,000	507,000
1969	2,112	10,708,000	753,000	521,000
1974	2,076	10,814,000	778,000	551,000
Utah				
1950	24,176	10,865,000	1,138,000	1,279,000
1954	22,826	12,262,000	1,073,000	1,228,000
1959	17,811	12,688,000	1,062,000	1,062,000
1964	15,759	12,868,000	1,092,000	1,039,000
1969	13,045	11,313,000	1,025,000	1,024,000
1974	12,184	10,610,000	970,000	1,089,000

3024-1

Source: Department of Commerce, 1977.

Table 3.2.3.8-3. Market value of agricultural products sold, Nevada/Utah study area counties, 1974.

COUNTY	VALUE OF AGRICULTURAL PRODUCTS SOLD (THOUSANDS OF DOLLARS)	VALUE OF CROPS AND HAY (PERCENT OF COUNTY TOTAL)	VALUE OF LIVESTOCK AND LIVESTOCK PRODUCTS (PERCENT OF COUNTY TOTAL)	OTHER PRODUCTS (PERCENT OF COUNTY TOTAL)	VALUE OF AGRICULTURAL PRODUCTS AS PROPORTION OF STATE TOTAL PERCENTAGE
Nevada					
Clark	7,734	9.8	89.3	0.9	5.8
Esmeralda	1,233	40.0	59.9	0.1	0.9
Eureka	3,476	35.8	64.2	0.0	2.6
Lander	3,821	22.3	77.7	0.0	2.9
Lincoln	2,096	17.5	82.5	0.0	1.6
Nye	3,068	38.8	60.9	0.3	2.3
Pershing	15,218	52.7	47.3	0.0	11.4
White Pine	3,399	9.9	88.5	1.6	2.5
Total	40,045	28.3	71.3	0.4	30.0
Utah					
Beaver	6,567	30.7	69.3	0.0	1.9
Iron	11,715	53.9	45.9	.2	3.4
Juab	3,102	37.6	62.3	.1	0.9
Millard	24,434	35.1	64.5	.4	7.2
Tooele	3,609	20.2	78.2	1.6	1.1
Total	49,451	38.1	61.6	0.2	14.6
Nevada/Utah Total	81,762	39.1	61.4	0.4	17.4

501-2

Source: Department of Commerce (1977).

Table 3.2.3.8-4. Cropland acreage Nevada/Utah study area counties, 1974.

COUNTY	TOTAL CROPLAND	HARVESTED CROPLAND	CROPLAND USED ONLY FOR PASTURE	LAND IRRIGATED	CROPLAND AS PROPORTION OF STATE CROPLAND
Clark	12,000	8,000	2,000	11,000	[illegible]
Esmeralda	[illegible]	4,000	[illegible]	[illegible]	[illegible]
Eureka	34,000	24,000	6,000	31,000	[illegible]
Lander	38,000	28,000	4,000	32,000	[illegible]
Lincoln	30,000	13,000	16,000	19,000	[illegible]
Nye	28,000	16,000	7,000	28,000	[illegible]
Pershing	38,000	35,000	3,000	36,000	[illegible]
White Pine	28,000	15,000	7,000	24,000	[illegible]
Nevada Total	214,000	143,000	47,000	189,000	29.4
Beaver	27,000	21,000	4,000	23,000	[illegible]
Iron	66,000	43,000	16,000	46,000	[illegible]
Juab	60,000	26,000	16,000	14,000	[illegible]
Millard	157,000	98,000	25,000	93,000	[illegible]
Tooele	39,000	18,000	14,000	15,000	[illegible]
Utah Total	349,000	206,000	75,000	191,000	[illegible]
Nevada/Utah Total	563,000	349,000	246,000	380,000	[illegible]

Source: Department of Commerce, 1977.

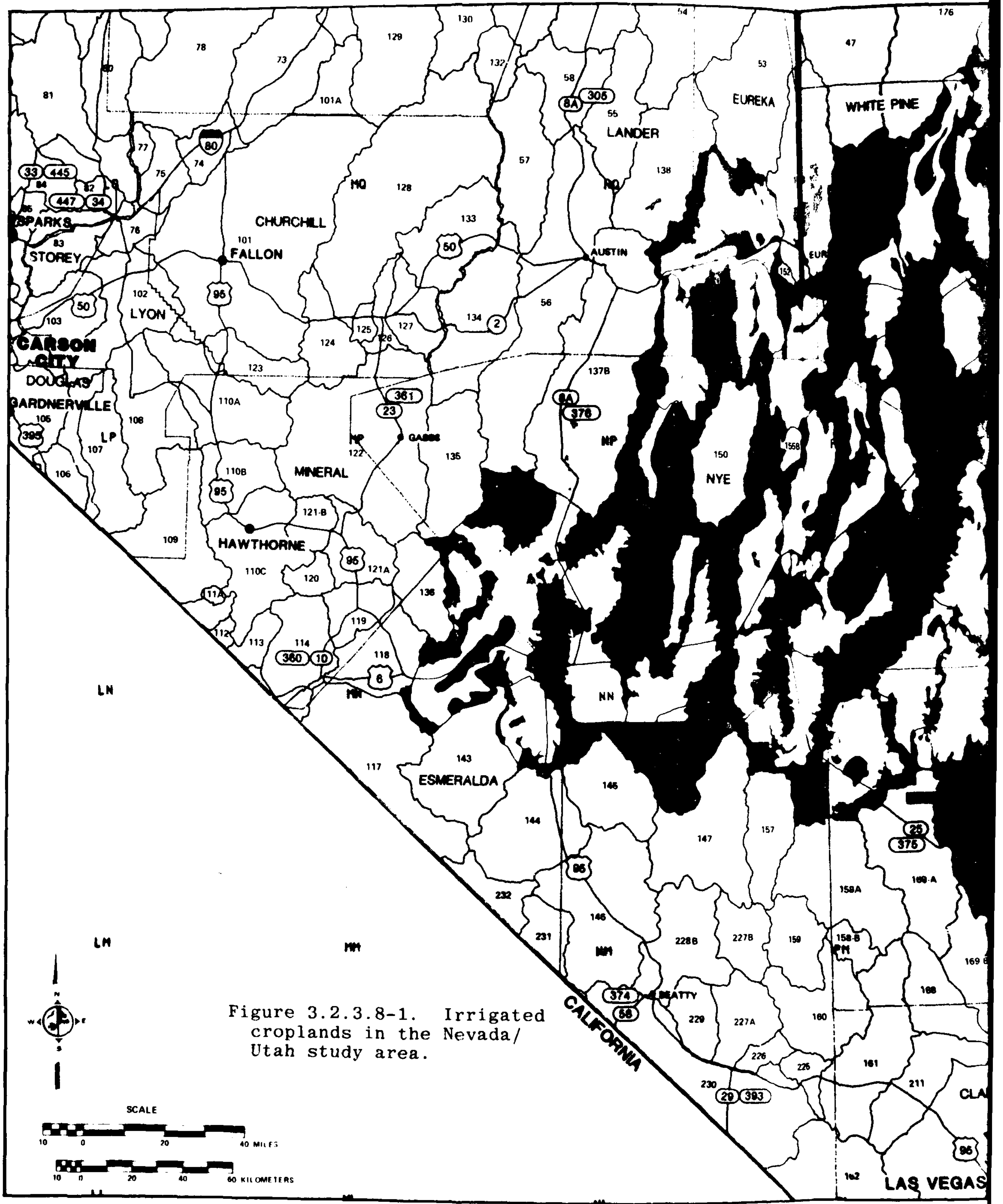
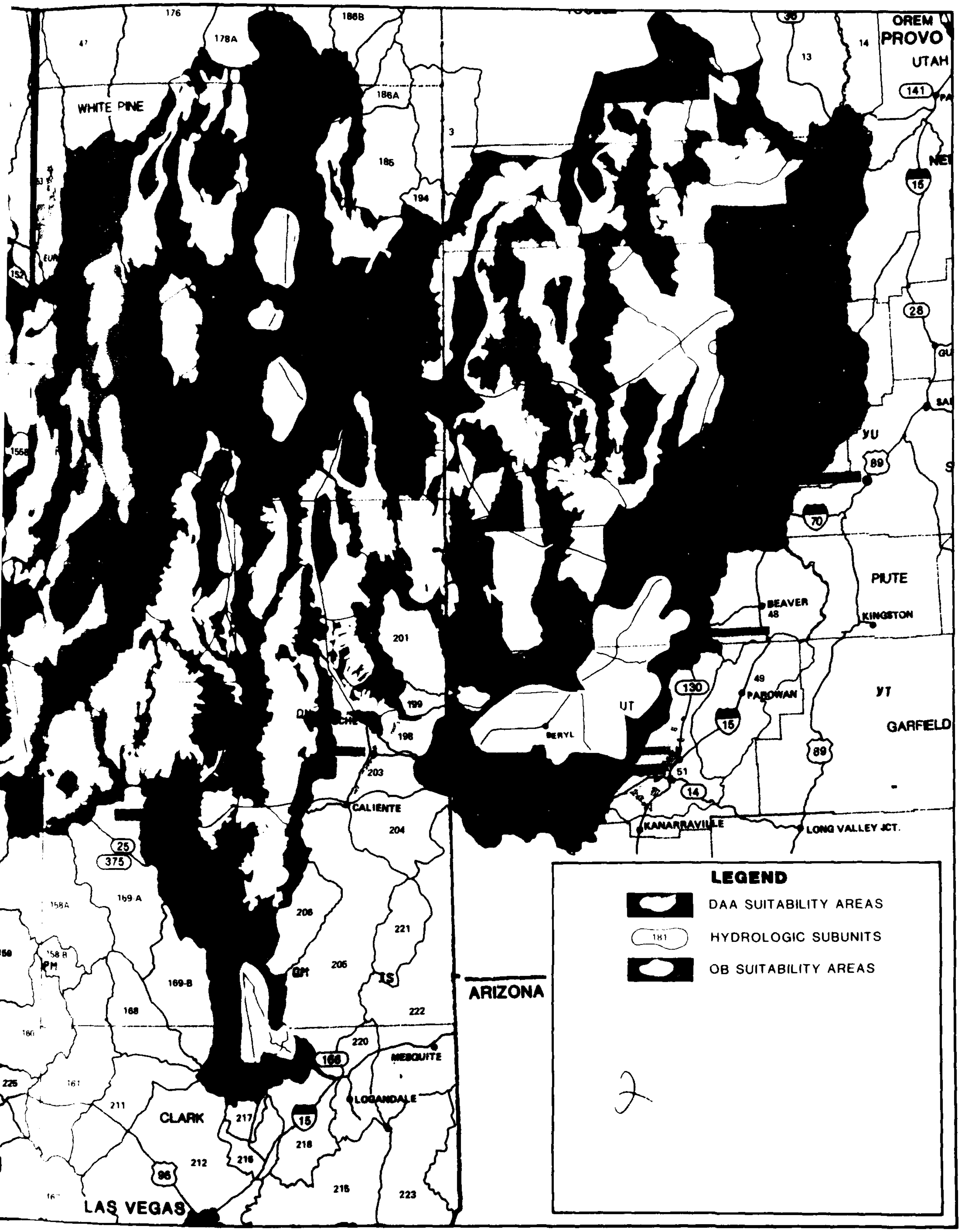


Figure 3.2.3.8-1. Irrigated croplands in the Nevada/ Utah study area.


176
178A
186B
OREM
PROVO
UTAH
13
14
141
WHITE PINE
186A
3
186
194
15
28
YU
89
70
PIUTE
BEAVER
48
KINGSTON
201
49
PAROWAN
GARFIELD
130
UT
199
15
198
BERYL
89
51
203
14
CALIENTE
204
KANARRAVILLE
LONG VALLEY JCT.
25
375
LEGEND
DAA SUITABILITY AREAS
181
HYDROLOGIC SUBUNITS
OB SUITABILITY AREAS
169-A
206
221
169-B
205
222
ARIZONA
168
220
MESQUITE
168
LOGANDALE
211
CLARK
217
15
218
212
216
95
215
223
LAS VEGAS

3222-D

There are over 36 million acres of BLM-administered land in the Nevada/Utah study area. Most of this is grazed; still more is grazable.

Degree of slope (greater than 50 percent) can render land ungrazable, but water is the vital limiting factor. Cattle will not travel further than about 4 mi from water. Present distribution of water sources is such that approximately 15 percent of the Caliente District and 8 percent of the Tonopah District are unused because water is unavailable. In areas where water is available, distribution is generally inadequate for optimum vegetation utilization by livestock, wildlife, wild horses, and burros.

The BLM regulates grazing on the extensive lands through the use of permits, regulated on the basis of animal unit months (AUMs). (An AUM is the forage required to keep one mature cow, or its equivalent, or five sheep for one month). *There were 1,766,479 AUMs on lands under BLM jurisdiction in 1979* (Table 3.2.3.8-5).

Livestock inventories for sheep and cattle for the years 1974 and 1978 are listed in Table 3.2.3.8-6. The hog population in both states is substantially less, holding at about 10,000 and 40,000 head in Nevada and Utah, respectively, from 1970-1978.

Recreation

Nevada/Utah

Most of the natural resource recreational areas and campgrounds are administered by the Bureau of Land Management, U.S. Forest Service, National Park Service, Nevada State Park System, and the Utah Division of Parks and Recreation. In Nevada, 85.2 percent (930,000 acres) of developed recreational areas are federal lands and 11.3 percent (123,000 acres) are state lands. In Utah, federal lands are 207,000 acres (62.0 percent) and the state provides 106,000 acres (31.3 percent). Tables 3.2.3.8-7 and 3.2.3.8-8 show the proportions of developed recreational land in Nevada and Utah administered by various agencies.

Campgrounds and Major Recreational Areas

There are major recreational facilities and campgrounds throughout the Nevada study area, but these are concentrated mainly in Clark, Lincoln, and White Pine counties. Although Elko County has more than ten major recreational areas, most are considered too distant from potential M-X deployment areas.

Most recreational facilities and campgrounds in Utah are located just east of the project area. Included are numerous U.S. Forest Service developments, state parks, and other developed areas of interest. Tooele, Juab, Millard, Beaver, and Iron counties all contain portions of National Forest Service lands on which numerous campgrounds and picnic areas are situated (Figures 3.2.3.8-2 and 3.2.3.8-3).

Water-based Recreation

Resident participation surveys conducted since 1975 show that the four major water-oriented recreational activities -- swimming, boating, fishing, and

Table 3.2.3.8-5. Distribution of animal unit months (AUMs) by BLM Planning Units, 1979.

NEVADA			
PLANNING UNITS	AUMS	PLANNING UNITS	AUMS
Elko District		Ely District	
Buckhorn	86,610	Moriah	145,942
Currie	118,709	White River	65,964
Total	205,319	Lake Valley	12,308
Battle Mountain District		Wilson Creek	55,326
Cortez	112,688	Steptoe	20,359
Mount Airy	69,717	Butte	27,288
Pony Express	71,441	Newark	71,263
Devil's Gate	61,675	Duckwater	30,069
Tonopah PA West	68,201	Preston Land	39,482
Tonopah PA East	85,329	Horse and Cattle Camp	21,565
Total	469,566	Total	489,566
Las Vegas District			
Caliente	78,235	Nevada Study Area Total	1,242,171
UTAH			
PLANNING UNITS	AUMS	PLANNING UNITS	AUMS
Salt Lake City District		Richfield District	
Gold Hill	21,336	Topaz	74,105
Skull Valley-Lakeside	82,773	Confusion	88,261
Onaqui-Aquirrh	21,321	Tintic	39,030
Total	125,430	Warm Springs	73,535
Cedar City District		Total	274,931
Cedar	36,572		
Pinyon	87,375	Utah Study Area Total	524,308
Beaver	48,818		
Total	123,947	NEVADA/UTAH STUDY AREA TOTAL	1,766,479

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Source: BLM Planning Unit Documents.

Table 3.2.3.8-6. Livestock inventories, Nevada/Utah study area counties, 1974 and 1978 (in thousands).

COUNTY	CATTLE			SHEEP		
	1974	1978	PERCENT OF TOTAL STATE PRODUCTION	1974	1978	PERCENT OF TOTAL STATE PRODUCTION
Nevada						
Clark	15	17	3.0	*	*	
Esmeralda	6	6	2.0	*	*	
Eureka	31	34	6.0	14	5	4.4
Lander	34	31	5.4	4	5	4.4
Lincoln	26	21	3.7	*	*	
Nye	32	27	4.7	6	4	3.5
Pershing	39	35	6.1	18	6	5.3
White Pine	26	21	3.7	34	24	21.0
Nevada Study Area Totals	210	192	33.7	76	44	38.6
Utah						
Beaver	25	26[1]	3.0	4	3[1]	0.6
Iron	23	24[1]	2.8	56	36[1]	7.3
Juab	16	17[1]	2.0	7	4[1]	0.8
Millard	67	70[1]	8.1	13	8[1]	1.6
Tooele	14	15[1]	1.7	29	18[1]	3.7
Utah Study Area Totals	145	152	17.6	109	69	14.0
Regional Totals	355	344	23.7	185	113	18.7

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*Less than 500 sheep.

[1]Utah estimates are derived by assuming that each country's share of the state output has remained constant since 1974.

Source: Nevada Agricultural Statistics, 1977; Utah Agricultural Statistics, 1978.

Table 3.2.3.8-7. Outdoor recreation facility inventory--acres of land facilities, Nevada, 1976 (acres).[1]

COUNTY	FEDERAL[2]	PER-CENT	STATE	PER-CENT	COUNTIES	PER-CENT	COMMUNITIES	PER-CENT	PRIVATE	PER-CENT	SCHOOLS	PER-CENT	TOTAL
Churchill	141,579	89.7	4,833	3.1	71	0.0	15	0.0	11,304	7.2	—	—	157,868
Clark	62,192	47.4	64,534	49.2	617	0.5	1,616	1.2	1,334	1.5	257	0.2	131,150
Elko	159,814	90.1	—	—	245	0.1	257	0.1	15,743	8.9	—	—	176,059
Esmeralda	—	—	15	2.9	—	—	—	—	500	97.1	—	—	515
Eureka	—	—	—	—	1	0.0	31	4.4	667	95.4	—	—	699
Humboldt	6	2.7	46	20.9	17	7.7	125	56.8	26	11.8	—	—	220
Lander	66	17.1	296	76.5	—	—	1	0.3	24	6.2	—	—	387
Lincoln	7,341	50.4	5,365	36.8	7	0.0	13	0.0	1,852	12.7	—	—	14,578
Mineral	3,089	99.5	1	0.0	7	0.2	—	—	7	0.2	—	—	3,104
Nye	56	0.2	29,175	99.6	—	—	17	0.0	52	0.2	—	—	29,300
Pershing	—	—	16,712	88.1	—	—	1	0.0	2,252	11.9	—	—	18,965
White Pine	551,922	99.6	1,828	0.3	62	0.0	67	0.0	98	0.0	—	—	553,907
Region	926,065	85.2	122,871	11.3	1,027	0.1	2,143	0.2	34,459	3.2	257	<.1	1,086,822

[1] These data were collected via a mailed questionnaire, variations in the figures may be due to a variation in the response by the agencies.

[2] Bureau of Indian Affairs recreational acreage included.

Source: Nevada State Park System, 1977.

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Table 3.2.3.8-8. Outdoor recreation facility inventory--acres of land facilities, Utah, 1976 (acres).[1]

COUNTY	FEDERAL	PER CENT	STATE	PER-CENT	COUNTIES	PER-CENT	COMMUNITIES	PER-CENT	PRIVATE	PER CENT	SCHOOLS	PER CENT	TOTAL
Beaver	2,716	74.8	230	6.3	15	0.4	282	7.8	354	9.7	35	1.0	3,632
Iron	1,588	57.7	123	4.5	24	0.9	138	5.0	790	28.7	89	3.2	2,752
Juab	78,982	99.7	40	<0.1	8	<0.1	124	0.2	14	<0.1	33	<0.1	79,220
Millard	875	12.5	5,711	81.7	85	1.2	97	1.4	147	2.1	73	1.0	6,988
Paiute	483	29.0	120	7.2	—	—	40	2.4	1,007	60.4	18	1.1	1,668
Salt Lake	689	5.5	2,387	19.0	1,507	12.0	1,495	11.9	4,674	37.2	1,804	14.4	12,556
Sanpete	660	22.0	98	3.3	61	2.0	64	2.1	1,716	57.1	405	13.5	3,004
Sevier	1,307	65.9	—	—	20	1.0	117	5.9	495	25.0	44	2.2	1,983
Tooele	2,303	1.2	192,361	98.3	35	0.02	99	0.05	794	0.4	158	0.8	195,750
Utah	1,559	16.1	186	1.9	—	—	1,485	15.3	5,866	60.5	601	6.2	9,697
Washington	14,829	67.8	6,407	29.3	—	—	139	0.6	409	1.9	78	0.4	21,862
Region	105,991	31.3	207,663	61.2	1,755	0.5	4,080	1.2	16,266	4.8	3,338	1.0	339,093

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[1] These data were collected via a mailed questionnaire, variations in the figures may be due to a variation in the response by the agencies.

[2] Bureau of Indian Affairs recreational acreage included.

Source: Institute for the Study of Outdoor Recreation and Tourism, 1976.

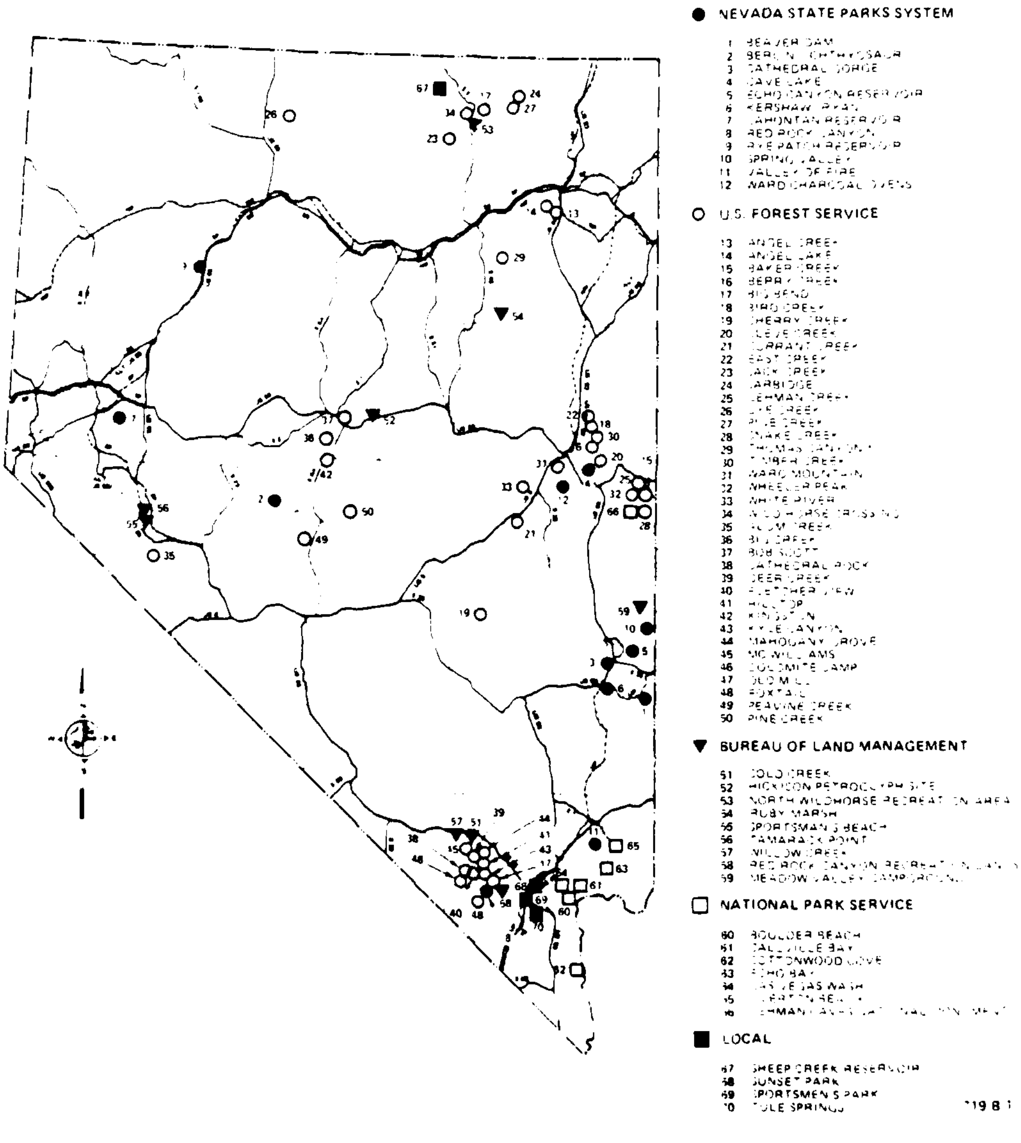


Figure 3.2.3.8-2. Major outdoor recreation facilities in Nevada.

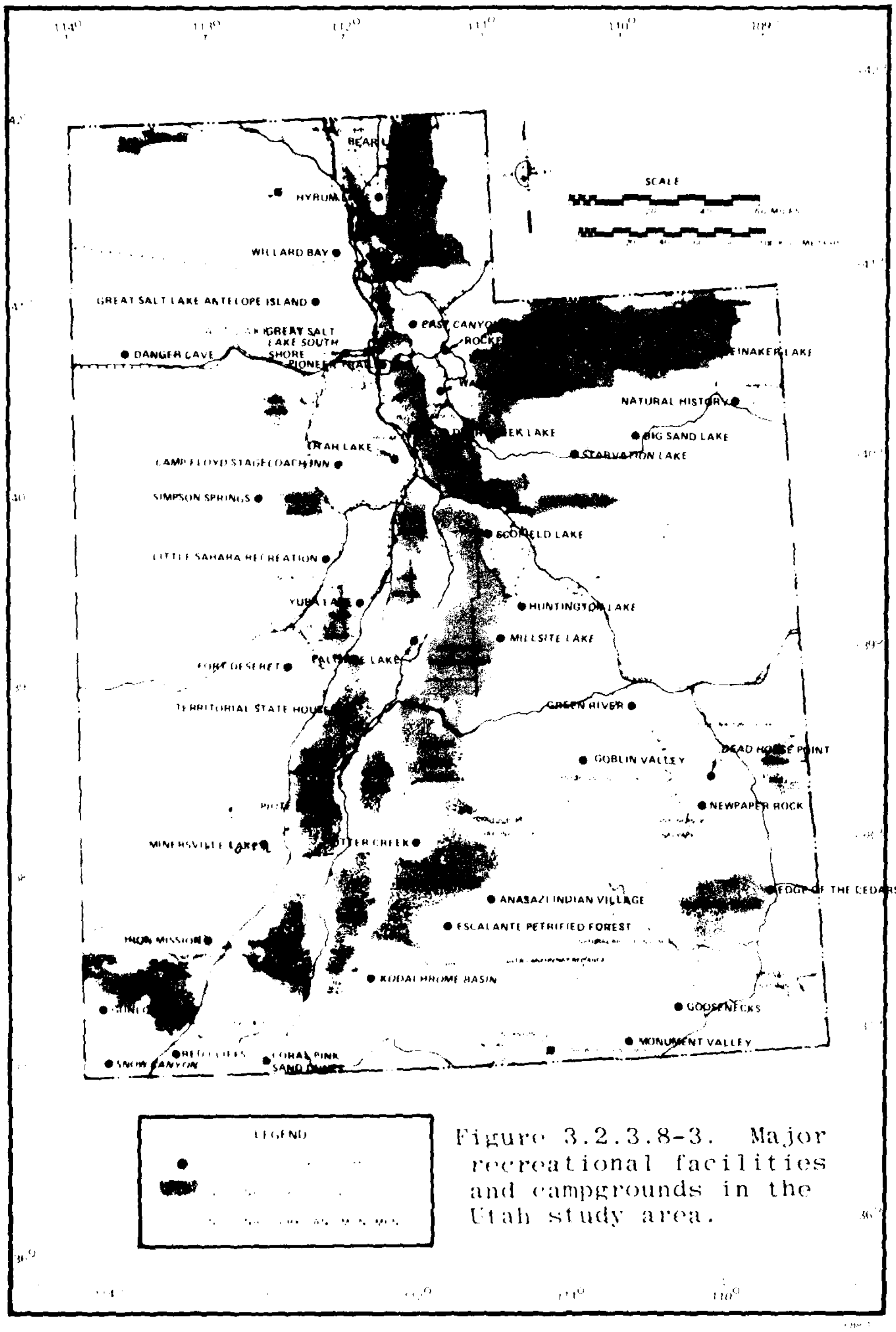


Figure 3.2.3.8-3. Major recreational facilities and campgrounds in the Utah study area.

waterskiing -- rank among the top recreational pursuits in the Nevada/Utah deployment area (Nevada State Park System 1977; Utah SCORP (Draft) 1978). Figure 3.2.3.8-4 shows the location of water-based recreational areas in the project area. Areas adjacent to water bodies are popular sites for recreational activities such as picnicking and camping. Existing lakes and reservoirs in Nevada are listed in Table 3.2.3.8-9; Table 3.2.3.8-10 shows areas of lakes in Utah. The majority of the Nevada portion of the study area contains nearly 160,000 surface acres of water in lakes and reservoirs, all capable of supporting water-based recreation. Lakes proximal to potential deployment areas (less than 60 mi) in Utah comprise more than 1 million surface acres. However, more than 90 percent of those are attributable to the presence of the Great Salt Lake. Without the Great Salt Lake, approximately 113,000 surface acres of water-based recreation areas on lakes are available in western Utah.

Off-Road Vehicle (ORV) Recreation

ORVs are used in conjunction with hunting, fishing, camping, sightseeing, touring, and racing, and are enjoyed by both local residents and tourists. Much of the Nevada/Utah region is accessible and/or conducive to ORV use. Presently, ORV activity is widespread throughout the Nevada/Utah region. Concentrated or site-intensive use such as motorcross racing and hill climbing, are rather localized around population centers and developed sites such as the Little Sahara Complex in Utah.

Hunting

Hunting of big and upland game is an important form of recreation in Nevada/Utah. Hunting waterfowl and furbearers is of lesser importance, primarily because of the limited resources present in these states.

Big game hunting is regulated by permit in both Nevada and Utah. Surveys of animal abundance are conducted each year to determine the number of permits to be issued for each management unit. Population levels of most game animals have shown moderate to large population fluctuations over time as a result of numerous factors, particularly those related to human activities, and past harvest data reflect this. Figures 3.2.3.8-5 and 3.2.3.8-6 and Tables 3.2.3.8-11 and 3.2.3.8-12 show harvest data for big game animals in Nevada and Utah. Figures 3.2.3.8-7 through 3.2.3.8-11 show big game management areas for Nevada/Utah.

Upland game harvest has shown moderate to large annual fluctuations related to population trends, with dove harvest generally increasing over the past 25 years in both states. Sage grouse harvest in Utah has increased in the last 10 years, as have harvests of fox and coyote in Nevada (Tables 3.2.3.8-13 through 3.2.3.8-15).

Fishing

Sport fishing is one of the most popular recreation activities in Nevada and Utah. Table 3.2.3.8-16 is a list of the game fish in Nevada and Utah. Existing supplies of lake acres suitable for fishing in the states of Nevada and Utah are 351,287 surface acres and 441,400 surface acres, respectively (Nevada State Parks System, 1977; Utah Outdoor Recreation Agency, 1978). Fishing streams in Nevada and Utah are shown in Tables 3.2.3.8-17 and 3.2.3.8-18. The number and lengths of

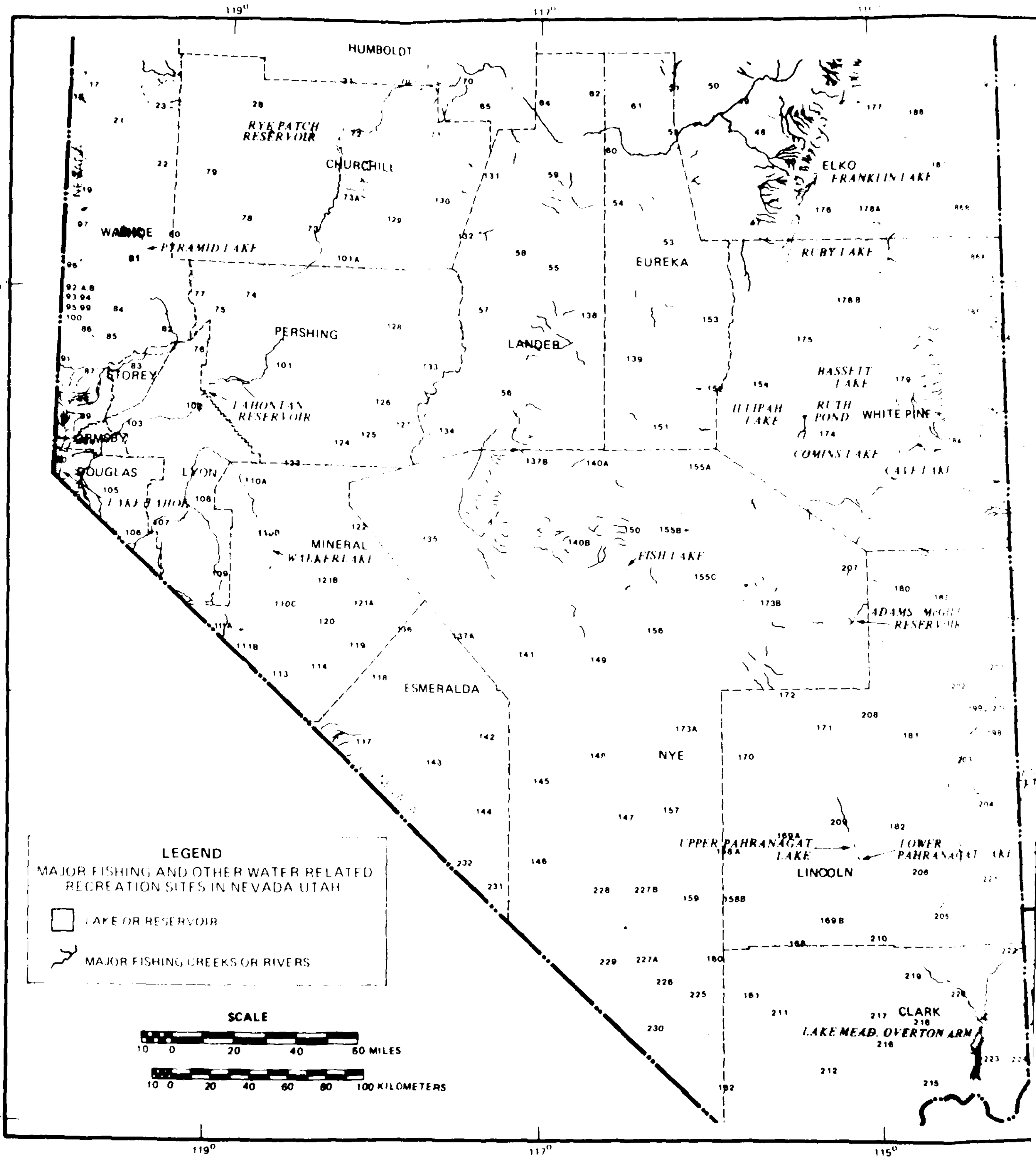
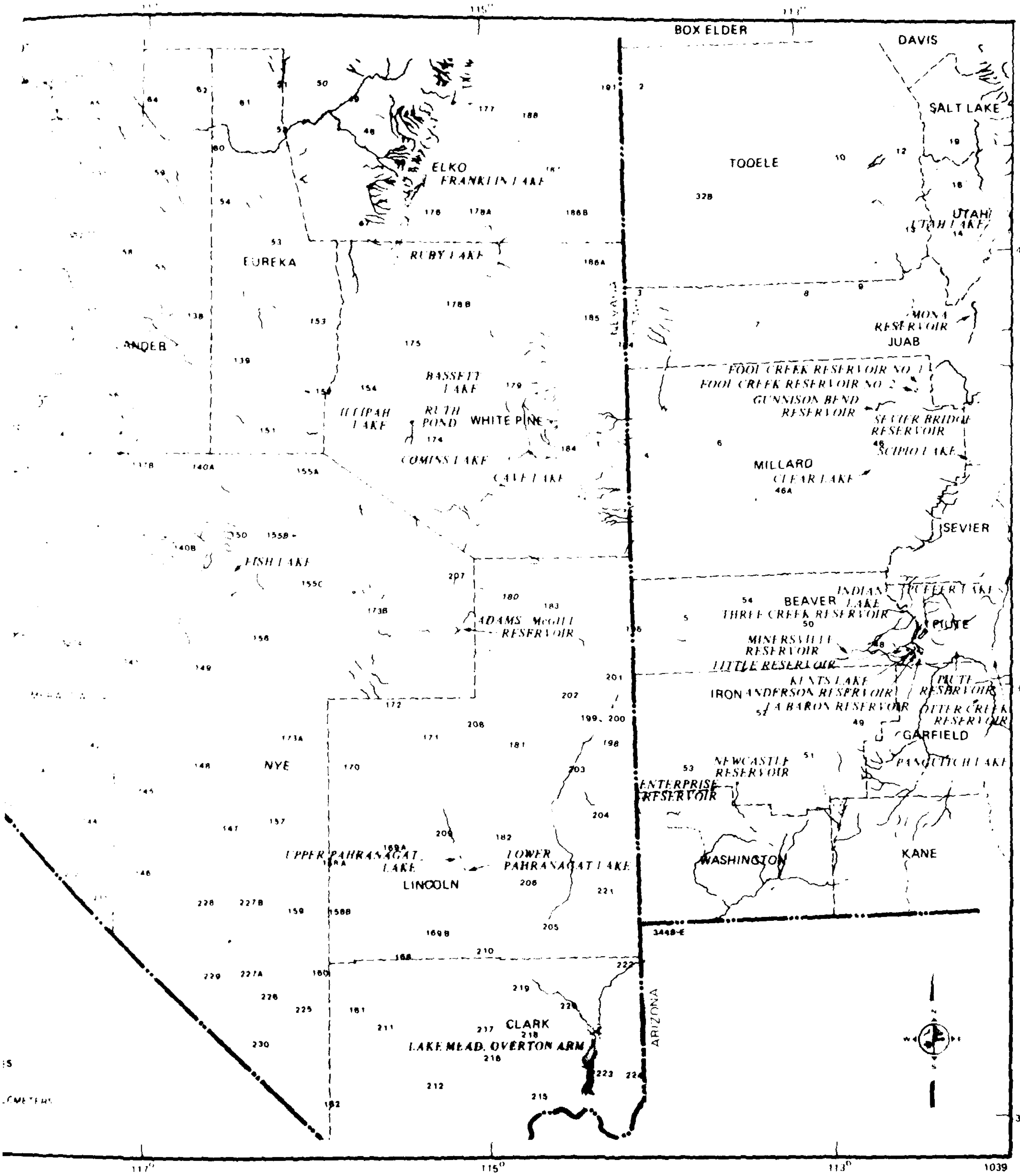


Figure 3.2.3.8-4. Water-based recreational areas in the Nevada/U



-1. Water-based recreational areas in the Nevada/Utah study area.

2

Table 3.2.3.8-9. Rank order of existing lakes and reservoirs in Nevada by size.

LAKE/RESERVOIR	SURFACE ACRES
Nevada	
Washoe, [illegible], Churchill, [illegible] Carson City, Douglas Counties	
Pyramid	[illegible]
Tahoe*	[illegible]
Lahontan	[illegible]
Washoe (Big and Little)	[illegible]
Stillwater Point	[illegible]
Topaz*	[illegible]
Indian Lakes	[illegible]
Big Soda Lake	[illegible]
Fort Churchill Cooling Ponds	[illegible]
Tracy Pond	[illegible]
Paradise Lake	25
Virginia Lake	24
Nye, Esmeralda and Mineral Counties	
Walker	[illegible]
Weber Reservoir	[illegible]
Lake [illegible] Adams-McGill	[illegible]
Haymeadow Reservoir	[illegible]
Clark County	
Mead*	[illegible]
Mohave*	[illegible]
Eureka, White Pine, and Lincoln Counties	
Ruby Marsh	[illegible]
Bassett Lake	[illegible]
[illegible] Reservoir	[illegible]
Eagle Valley Reservoir	[illegible]
Cave Lake	[illegible]
Illipah Reservoir	[illegible]
Beaver Dam	[illegible]
[illegible] Lake	[illegible]
[illegible] Creek Reservoir	[illegible]
[illegible] Reservoir	4
Elko County	
Ruby Marsh	4,[illegible]
Wildhorse	[illegible]
[illegible] Creek Reservoir	[illegible]
Wilson Reservoir	[illegible]
Willow Creek Reservoir	[illegible]
Bull Run Reservoir	[illegible]
[illegible] Creek Reservoir	[illegible]
Liberty Lake	[illegible]
Overland Lake	[illegible]
Favre Lake	[illegible]
Robertson Lake	[illegible]
Angel Lake	[illegible]
Hidden Lake	[illegible]
Island Lake	[illegible]
Lander, Pershing, and Humboldt Counties	
Rye Patch	[illegible]
[illegible] Creek Reservoir	[illegible]
Summit Lake	[illegible]
[illegible] Valley	[illegible]
Knott Creek Reservoir	[illegible]
Little [illegible]	[illegible]
[illegible] Pond	[illegible]
Smith Reservoir	[illegible]
Groves Lake	[illegible]
Iowa Reservoir	15
Blue Lakes	11
NEVADA TOTAL	351,722

LAKE/RESERVOIR	SURFACE ACRES
Utah	
Great Salt Lake**	[illegible]
Utah Lake**	[illegible]
Bear Lake	[illegible]
Yuba Lake**	[illegible]
Willard Bay	[illegible]
Scofield Lake	[illegible]
Starvation Lake	[illegible]
Otter Creek Lake	[illegible]
Deer Creek Lake**	[illegible]
Piute Lake**	[illegible]
Minersville Lake**	[illegible]
Rockport Lake	[illegible]
Steinaker Lake	[illegible]
East Canyon Lake	[illegible]
Hyrum Lake	[illegible]
Millsite Lake	[illegible]
[illegible] Lake	[illegible]
Lost Creek Lake	[illegible]
Gunlock Lake**	[illegible]
Huntington Lake	[illegible]
Palisade Lake**	[illegible]
UTAH TOTAL	[illegible]

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*Averages shown here are estimates of areas on the Nevada portion of these lakes.

**Denotes that water body is proximal to potential deployment areas (< 60 miles).

Sources: Nevada State Park System, 1977.
Utah Bureau of Economic and Business Research, Jan. 1979.

Table 3.2.3.8-10. Rank order of existing lakes by size in Utah.

LAKE	SURFACE ACRES	LAKE	SURFACE ACRES
Great Salt Lake*	960,000	Rockport Lake	1,030
Utah Lake*	95,900	Steinaker Lake	795
Bear Lake	71,000	East Canyon Lake	681
Yuba Lake*	10,700	Hyrum Lake	457
Willard Bay	9,920	Millsite Lake	435
Scofield Lake	2,804	Big Sand Lake	393
Starvation Lake	2,760	Lost Creek Lake	365
Other Creek Lake	2,520	Gunlock Lake*	240
Deer Creek Lake*	2,435	Huntington Lake	237
Piute Lake*	2,250	Palisade Lake*	31
Minersville Lake*	1,130	Utah Total	1,170,203

*Denotes that water body is proximal to potential deployment areas (< 60 miles). 393

Source: Utah Bureau of Economic and Business Research, Jan. 1979.

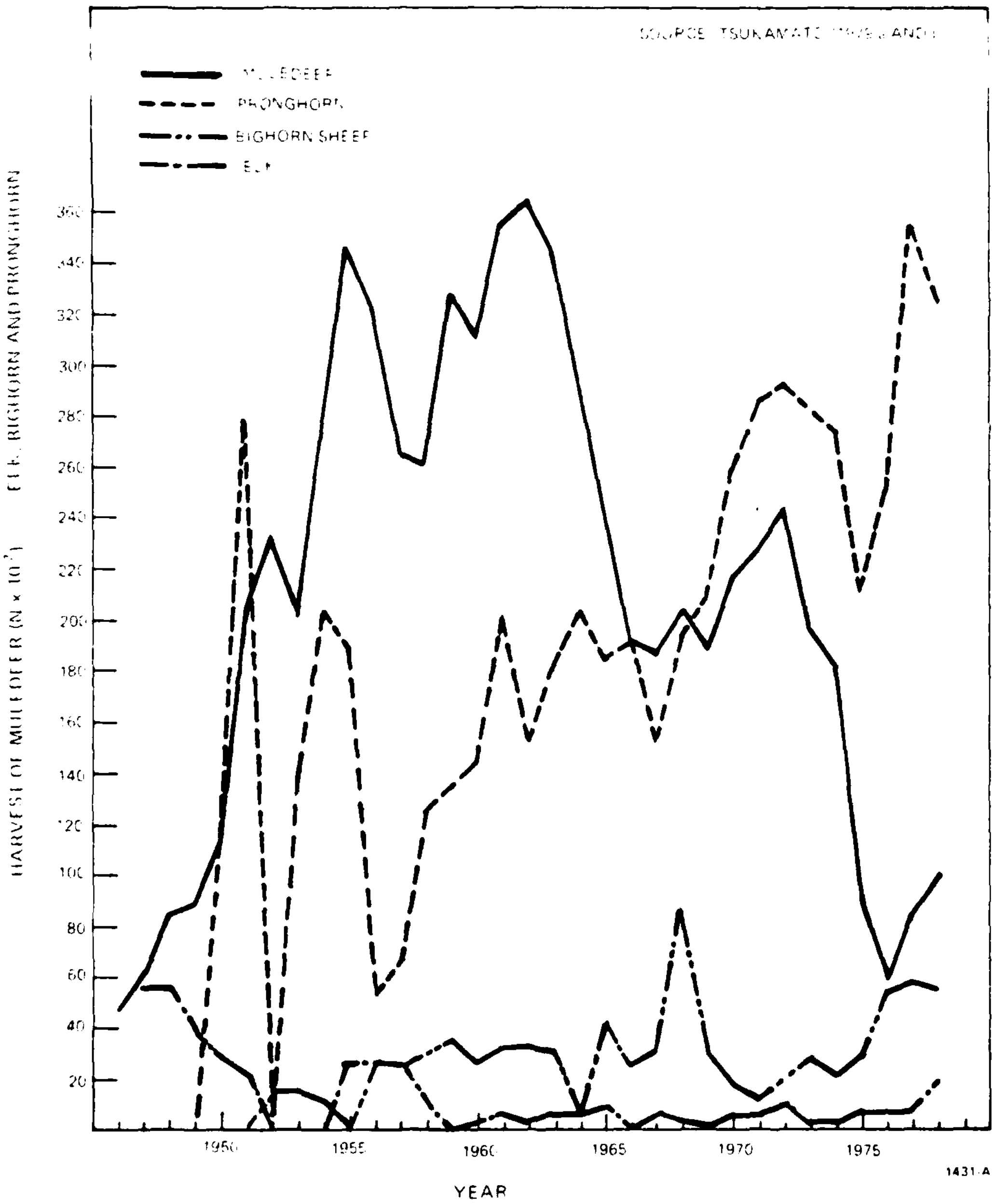


Figure 3.2.3.8-5. Big game harvest in Nevada.

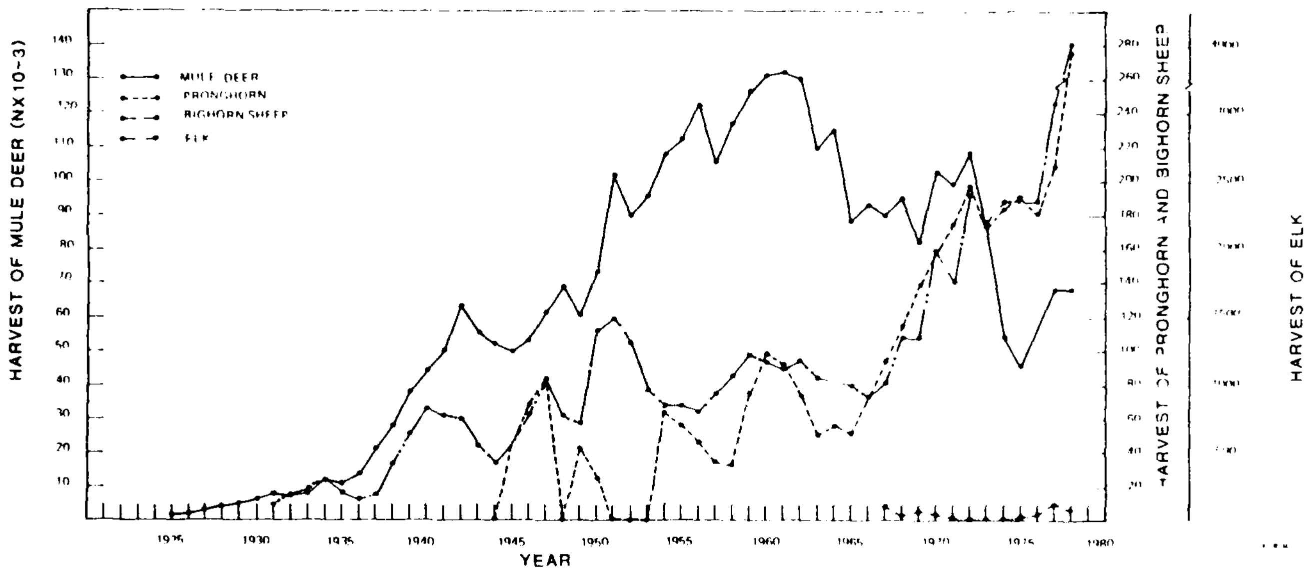


Figure 3.2.3.8-6. Big game harvest in Utah.

Table 3.2.3.8-11. Pronghorn, bighorn sheep, and elk harvest by management unit for 1978 for those areas in the potential study area.

MANAGEMENT AREA[a]	PRONGHORN		BIGHORN SHEEP		ELK	
	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS
NEVADA						
10	10	11				
11	21	29			19	20
16	2	5				
20		Closed				
22		Closed				
2[illegible]	6	10				
15A	-	-				
15B	4	5				
71			1	2		
72			2	5		
73			3	4		
74			4	-		
75			4	4		
76			6	6		
77			4	5		
78			6	6		
79			2	6		
80			5	11		
Sub Total	51		41			
STATE TOTAL	124	387	55	81	19	2[illegible]
UTAH						
Cedar City	5	5				
Southwest Desert	29	35				
West Desert						
Riverbed	11	15				
Snake Valley	12	15				
4					17	20
18					1	10
Sub Total	58		0		18	
STATE TOTAL	276	52[illegible]	7	2[illegible]	4,09[illegible]	2[illegible],564

[a]See Figure [illegible] for management area locations.

Source: Tsukamoto, 1979b; Jense and Burruss, 1979.

Table 3.2.3.8-12. Mule deer and mountain lion harvest by management area for 1978 for those areas within the potential study area.

MANAGEMENT AREA[a]	MULE DEER[b]		MOUNTAIN LION	
	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS
NEVADA				
[illegible]			[illegible]	[illegible]
[illegible]			4	14
[illegible]	[illegible],42[illegible]	[illegible],048		[illegible]
[illegible]	958	[illegible],605	1	[illegible]
[illegible]	184	404	1	[illegible]
[illegible]	[illegible]	1,000		
14	411	941		
[illegible]	[illegible]	50[illegible]	[illegible]	4
[illegible]	38[illegible]	95[illegible]	1	[illegible]
[illegible]	22[illegible]	[illegible]4[illegible]	[illegible]	4
[illegible]	[illegible]	10[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]
[illegible]	23[illegible]	[illegible]	5	14
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4
[illegible]	175	542	[illegible]	[illegible]
[illegible]4	122	[illegible]	[illegible]	[illegible]
[illegible]5	1[illegible]	4[illegible]	[illegible]	[illegible]
Sub Total	5,[illegible]		32	
STATE TOTAL	[illegible]	[illegible]	[illegible]	201
UTAH				
[illegible]	[illegible]	4,755		
[illegible]	[illegible]	[illegible],541		
[illegible]	[illegible]	2,786		
[illegible]	[illegible]	[illegible],57[illegible]		
[illegible]	[illegible]	[illegible],351		
[illegible]	[illegible]	[illegible],90[illegible]		
[illegible]	[illegible]	[illegible],78[illegible]		
[illegible]	[illegible]	[illegible],14[illegible]		
56B	14[illegible]	49[illegible]		
[illegible]	[illegible]	1,[illegible]		
[illegible]A	17[illegible]	566		
62B	[illegible]	19[illegible]		
[illegible]	11[illegible]	[illegible]		
Sub Total	[illegible]			
STATE TOTAL	66,[illegible]	1[illegible],951	N.D.[c]	N.D.

[a]Management areas for mule deer and mountain lion do not have the same boundaries although numbered the same. [illegible]
[b]Harvest includes regular license, [illegible] permits, and primitive weapons.
[c]No data available.
[illegible] Tsukamoto, 1979[illegible]; [illegible] and [illegible], 197[illegible].

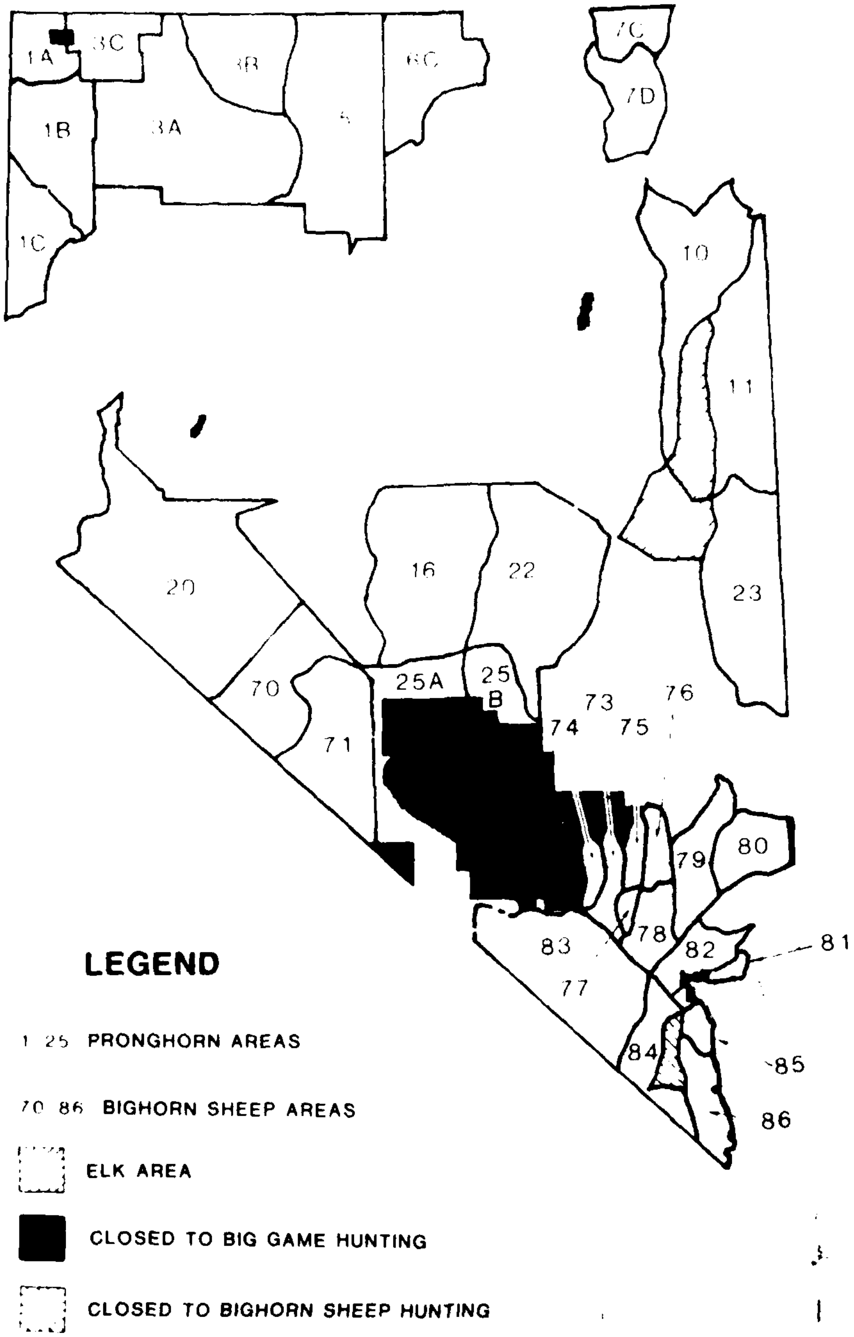


Figure 3.2.3.8-7. Pronghorn, bighorn sheep and elk management areas in Nevada.

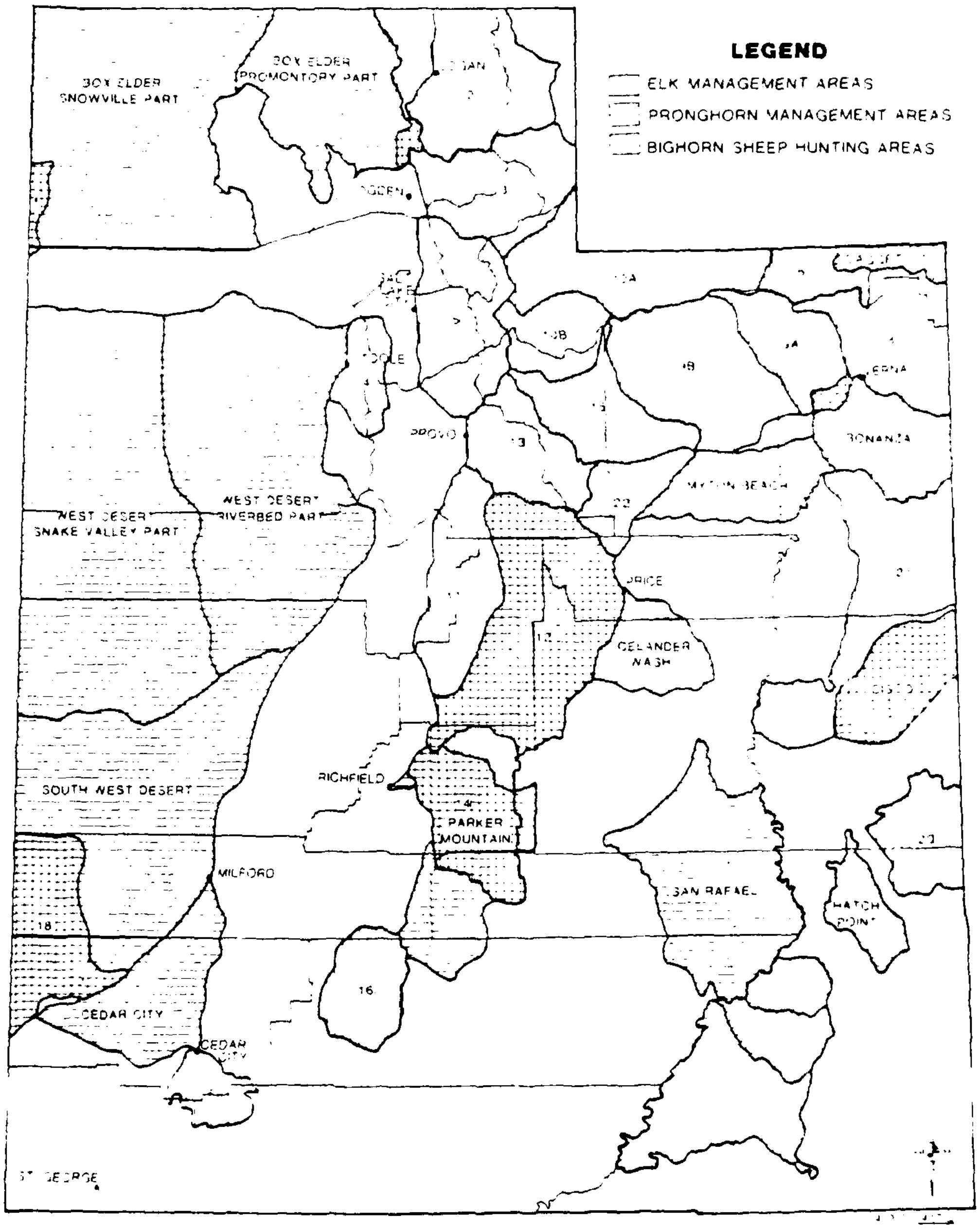


Figure 3.2.3.8-8. Big game management areas in Utah.

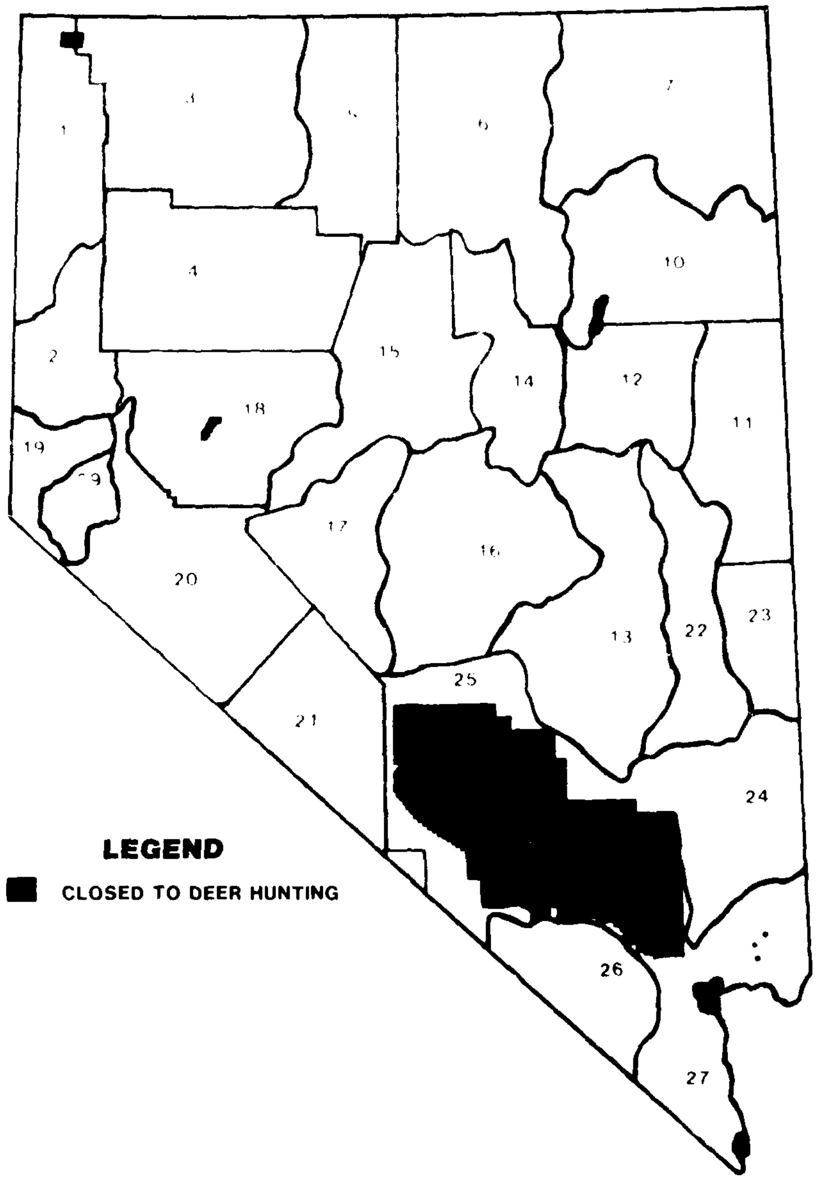


Figure 3.2.3.8-9. Mule deer management units in Nevada.

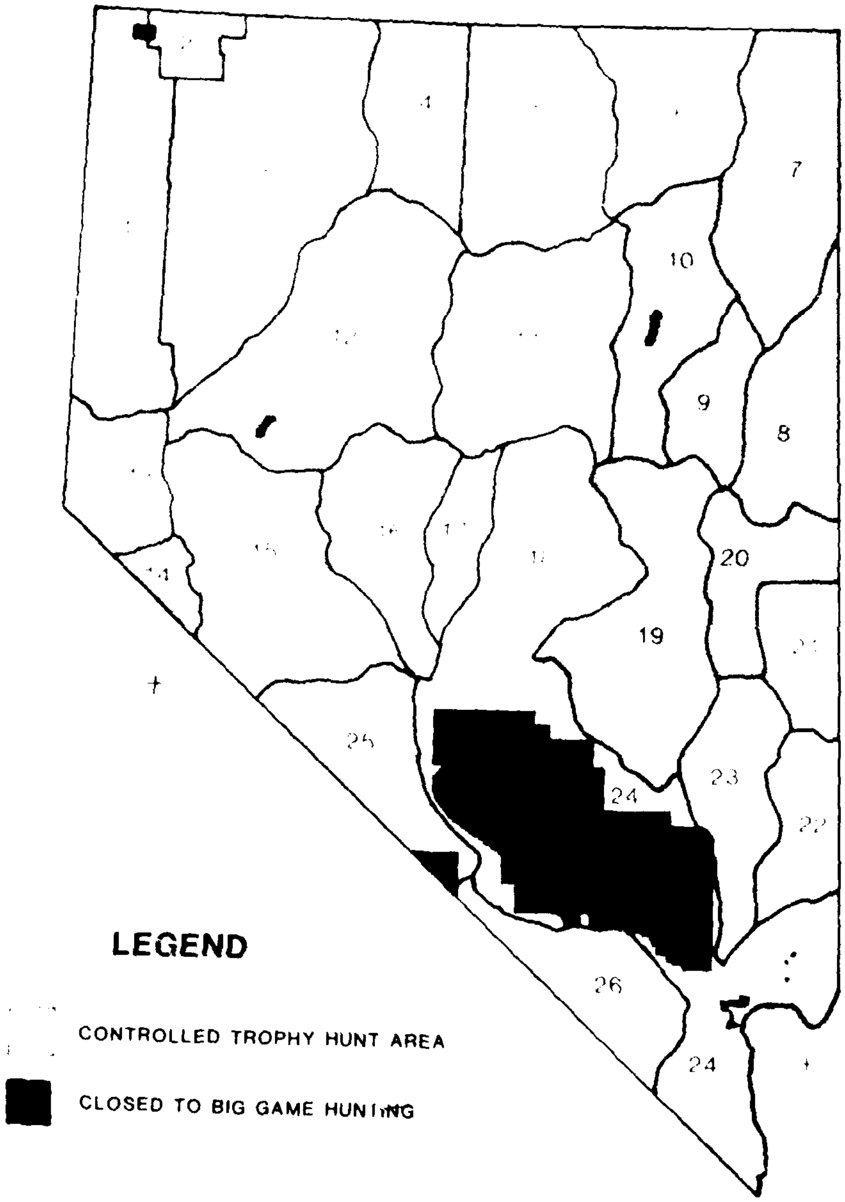


Figure 3.2.3.8-10. Mountain lion management areas in Nevada.

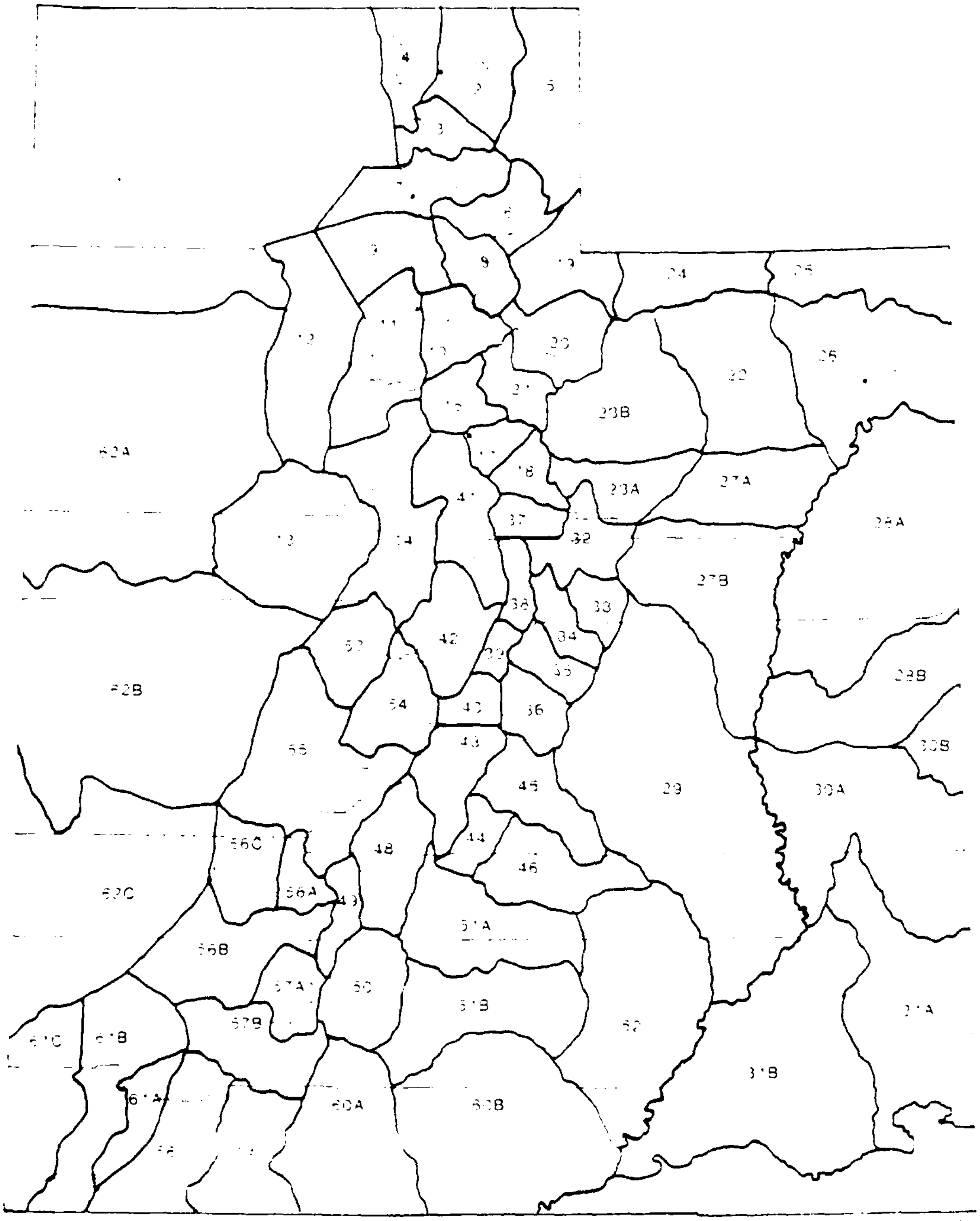


Figure 3.2.3.8-11. Mule deer management areas in Utah.

Table 3.2.3.8-13. Upland game harvest by county in 1978 for the Nevada/Utah study area.

STATE COUNTY	SAGE GROUSE		CHUKAR		QUAIL		DOVE		RABBIT		OTHER[1]	
	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS
NEVADA												
Clark	13	3	462	100	39,250	3,376	41,340	2,872	31,017	3,071	135	257
Elko	6,222	2,122	12,296	1,493	65	31	2,558	325	6,304	962	2,718	987
Esmeralda	0	1	2,470	349	40	5	753	[illegible]	603	91	0	0
Eureka	1,153	368	2,456	100	366	44	897	134	442	81	57	11
Lander	1,724	880	3,708	588	154	80	445	78	2,739	[illegible]	482	212
Lincoln	0	0	124	63	9,181	816	8,155	556	9,218	746	4	4
Mineral	244	152	4,375	442	274	50	1,373	127	2,075	381	48	14
Nye	1,939	720	7,743	1,166	3,342	478	13,325	1,114	6,925	983	77	75
White Pine	1,596	640	287	97	0	0	2,874	229	5,541	607	871	400
Sub Total	13,301		33,921		53,172		71,720		55,646		4,392	
STATE TOTAL	17,693	6,765	108,775	14,561	104,939	9,765	113,048	9,860	99,817	11,628	10,219	5,251
UTAH												
Beaver	360	174	0	11	0	0	6,465	317	3,562	345	1,721	196
Iron	300	229	0	11	0	26	16,132	997	4,564	673	3,303	1,102
Juab	240	153	580	277	120	17	34,065	2,112	20,684	1,555	3,282	1,133
Millard	40	44	981	301	80	78	35,606	1,922	6,618	290	10,367	3,351
Tooele	260	261	11,008	3,108	0	35	23,697	2,051	10,788	3,716	6,825	2,729
Sub Total	1,200		12,569		200		115,965		102,211		25,198	
STATE TOTAL	25,938	16,231	65,747	16,291	15,491	6,921	383,606	35,985	401,071	35,590	311,335	113,961

[1]Includes pheasant, blue and ruffed grouse, and Hungarian partridge.

Source: Molini and Barngrover, 1979; Featham and Bonnell, 1979.

Table 3.2.3.8-14. Furbearer harvest by county in 1978 for selected counties in the study area.

STATE COUNTY	BOBCAT		FOX[1]		COYOTE		MUSKRAT		BEAVER		OTHER[2]	
	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS
NEVADA												
Clark	526		457		527		200		0		91	
Elko	357		106		1,760		2,760		46		312	
Esmeralda	130		18		65		0		0		8	
Eureka	107		21		243		6		13		16	
Lander	353		27		297		0		6		46	
Lincoln	523		443		1,002		115		0		93	
Mineral	199		292		396		37		42		29	
Nye	308		230		489		1		1		79	
White Pine	211		136		416		1,192		13		60	
Sub Total	2,714		1,730		5,095		4,311		141		734	
STATE TOTAL	4,542	909	2,322	909	8,458	909	9,898	909	715	909	1,261	909
UTAH												
Beaver							N/A	N/A	1	0		
Iron							N/A	N/A	4	0		
Juab							N/A	N/A	8	3		
Millard							349	N/A	0	0		
Tooele							N/A	N/A	0	0		
Sub Total							349		13			
STATE TOTAL	N/A[3]	N/A	N/A	N/A	N/A	N/A	11,790	N/A	2,958	213	279	76

731

[1] Gray and kit fox.

[2] Includes ringtail cat, mink, otter, skunk, weasel, raccoon, and badger in Nevada; marten and mink in Utah.

[3] N/A = Not available in state harvest reports.

Source: Molini and Barngrover, 1979; Frost, 1979.

Table 3.2.3.8-15. Waterfowl harvest data by county in 1978 for the Nevada/Utah study area.

STATE COUNTY	DUCKS		GEESE		COOTS	
	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS	HARVEST	NUMBER HUNTERS
NEVADA						
Clark	8,369	1,262	443	1,262	367	206
Elko	5,536	666	166	666	0	0
Esmeralda	43	6	2	6	21	3
Eureka	1,100	119	7	119	9	9
Lander	202	73	0	73	3	3
Lincoln	6,513	898	68	898	748	136
Mineral	1,958	113	496	113	0	0
Nye	5,508	837	128	837	553	84
White Pine	1,051	201	5	201	0	0
Sub Total	30,280		1,315		1,701	
STATE TOTAL	104,840	12,452	6,940	12,452	3,184	805
UTAH[1]						
Beaver						
Iron						
Juab						
Millard						
Tooele						
Sub Total						
STATE TOTAL						

735-

[1]Data for Utah are presently not available.

Source: Molini and Barngrover, 1979.

Table 3.2.3.8-16. Game fish in Nevada and Utah.

COMMON NAME	SCIENTIFIC NAME	NEVADA	UTAH
SALMON, TROUT, GRAYLING & WHITEFISH	Family SALMONIDAE		
King Salmon	*Oncorhynchus tshawytscha*	X	
Kokanee Red Salmon	*O. nerka kennerlyi*	X	
Lake Trout	*Salvelinus namaycush*	X	
Brook Trout	*S. fontinalis*	X	
Dolly Varden Trout	*S. malma*	X	
Cutthroat Trout	*Salmo clarki*		
Lahontan Cutthroat Trout	*S. c. henshawi*	FT	FT
Colorado Cutthroat Trout	*S. c. pleuriticus*	X	
Utah Cutthroat Trout	*S. c. utah*	X	
Yellowstone Cutthroat Trout	*S. c. lewisi*	X	X
Humboldt Cutthroat Trout	*S. c. ssp.*	X	
Rainbow Trout	*S. gairdneri*		X
Coast Rainbow Trout	*S. g. irideus*	X	
Kamloops Rainbow Trout	*S. g. kamloops*	X	
Tahoe Rainbow Trout	*S. g. regalis*		
Pyramid Rainbow Trout	*S. g. smaragdus*	X	
Golden Trout	*S. aguabonita*	X	X
Brown Trout	*S. trutta*		X
Arctic Grayling	*Thymallus arcticus*		X
Mountain Whitefish	*Prosopium williamsoni*	X	X
Bonneville Cisco	*P. gemmiferum*		X
Bonneville Whitefish	*P. spilonotus*		X
Bear Lake Whitefish	*P. abyssicola*		X
PIKE	Family ESOCIDAE		
Northern Pike	*Esox lucius*		X
NORTH AMERICAN CATFISH	Family ICTALURIDAE		
Channel Catfish	*Ictalurus punctatus*	X	X
White Catfish	*I. catus*	X	
Brown Bullhead	*I. nebulosus*	X	
Black Bullhead	*I. melas*	X	X
Northern Black Bullhead	*I. m. melas*	X	
Southern Black Bullhead	*I. m. catulus*	X	
Yellow Bullhead	*I. natalis*		
PERCH	Family PERCIDAE		
Yellow Perch	*Perca flavescens*	X	
Walleye	*Stizostedion vitreum vitreum*		X
SUNFISH	Family CENTRARCHIDAE		
Sacramento Perch	*Archoplites interruptus*	X	X
Largemouth Bass	*Micropterus salmoides*	X	X
Smallmouth Bass	*M. dolomieui*	X	X
Striped Bass	*Morone saxatilis*	X	X
White Bass	*M. chrysops*	X	X
Bluegill Sunfish	*Lepomis macrochirus*	X	X
Green Sunfish	*L. cyanellus*	X	X
Black Crappie	*Pomoxis nigromaculatus*	X	X
White Crappie	*P. annularis*	X	X

NOTE: FT = Federally listed threatened species, caught as a game fish in Nevada and Utah.
[illegible] = State listed endangered species in Utah, caught as a gamefish in Nevada.

Table 3.2.3.8-17. Major fishing streams in Nevada.[1]

COUNTY	STREAM
Washoe, Storey, Churchill, Lyon, Carson City, and Douglas Cos.	Desert Sweetwater Thomas Bronco Galena Ash Canyon Clear
Nye, Esmeralda, and Mineral Cos.	Chiatovich Indian South Twin Barley Pine Reese Jett
Clark Co.	Cold Willow
Eureka, White Pine, and Lincoln Cos.	Roberts Fish Creek Cave Silver Baker Cleve Lehman
Elko Co.	Badger Blue Jacket Bull Run Bruneau Columbia Humboldt (N. & S. Fork) Owyhee (E. Fork) Jarbidge Mary's Lamoille
Lander, Pershing, and Humboldt Cos.	Little Humboldt R. (N. Fork) Martin Dutch John Rebel McDermitt Jackson Kings R. Mill Trout Willow Kingston Steiner Birch Big

[1] In all, there are [illegible],599 miles (4,1[illegible]7 km) of suitable fishing streams in Nevada.

Source: Nevada State Park System, 19[illegible].

Table 3.2.3.8-18. Streams with good to excellent fishery resources in selected western Utah counties.*

COUNTY	STREAM	COUNTY	STREAM
Tooele	S. Willow Creek Clover Creek	Iron	Castle Creek Louder Creek Asay Creek W. Fork Asay Creek Clear Creek Bunker Creek
Juab	Trout Creek Birch Creek Granite Creek Burnt Cedar Creek Sevier River Chicken Creek Pidgeon Creek	Piute	Deer Creek Beaver Creek Ten Mile Creek City Creek E. Fork Sevier River Otter Creek Box Creek S. Fork Box Creek Greenwich Creek
Millard	Lake Creek Oak Creek Pioneer Creek Chalk Creek N. Chalk Creek Choke Cherry Creek Meadow Creek Corn Creek S. Fork Corn Creek Maple Grove Springs	Sevier	Otter Creek Salina Creek Gooseberry Creek Meadow Creek Lost Creek Little Lost Creek Glenwood Creek Willow Creek Monroe Creek Doxford Creek Dry Creek Clear Creek Fish Creek Shingle Creek
Sanpete	Cedar Creek Birch Creek S. Fork Birch Creek S. Spring Creek Cottonwood Creek		
Salt Lake	Jordan River City Creek Red Butte Creek Parley Creek Mountain Dell Lambs Canyon R. Fork Lambs Canyon Mill Creek Big Cottonwood Creek Little Cottonwood Creek	Washington	Santa Clara River Water Canyon Leeds Creek Mill Creek N. Fork Virgin River

395

*Evaluations based on availability of game fish and overall rating of stream reach as per source.

Source: Wydoski, R.S., and Berry C.R., Dec. 29, 1976, *Atlas of Utah Stream Fishing Values*, Logan, Utah.

fishing streams in the study area hydrological subunits are shown in Table 3.2.3.8-19. The annual change in Nevada gamefish effort and harvest is shown in Table 3.2.3.8-20.

Snow-Related Activities

Snow-related recreational activities in Nevada and Utah consist mainly of downhill and cross-county skiing, snowshoeing, snow-mobiling, and free play. These activities are primarily concentrated in three main areas in Nevada and Utah: the Nevada/California border (Lake Tahoe area), the Mt. Charleston area (Clark County), and the national forests in central Utah. To a lesser extent, all other U.S. Forest Service holdings and other mountainous lands within the study area also are used for snow activities; however, because of their distance from large population centers and the abundance of higher quality alternatives, the demand is much less frequent. Such areas include east-central Lincoln County, Toiyabe National Forest in Nye, Lander, and Eureka counties, and Humboldt National Forest in White Pine County.

Native American Resources (3.2.3.9)

Cultural Resources (3.2.3.9.1)

Ancestral Sites and Occupation Areas

The area was occupied in late prehistoric and early historic times by the Northern Paiute, Shoshone, Southern Paiute, and Ute tribes (Figure 3.2.3.9-1). Much of the area lies in Shoshone traditional lands as well as in Southern Paiute ancestral lands in southeastern Nevada and southwestern Utah. Portions of the Sevier Desert, Desert-Dry Lake sub-area, and northern Milford Valley were occupied by the Western Ute in prehistoric and early historic times.

Sacred Areas

Sites with religious importance are burial grounds, cremation areas, rock art, special caves, springs, and selected physiographic features.

Gathering and Hunting Areas

Native flora and fauna are regularly used by Native Americans for food and other purposes. As in aboriginal times, pinenuts are the most important plant resource. Pinyon groves are distributed commonly in the mountain areas, as illustrated in Figure 3.2.3.9-2.

Native plants are used for medicinal purposes. Willow, juncus, devil's claw, and other riparian species are used for basket-making. Also gathered are special clays for pottery, decorative paints and glazes, and tempering materials such as mica and quartzite.

Table 3.2.3.8-19. Number of game fishing streams and their total length for hydrologic subunits within the study area.

NUMBER	UNIT NAME	NUMBER OF STREAMS	LENGTH OF STREAMS (mi)	NUMBER	UNIT NAME	NUMBER OF STREAMS	LENGTH OF STREAMS (mi)
4	Snake	15	122	150	Little Fish Creek	4	12
[illegible]	Sevier Desert	7	36	151	Antelope	1	5
47	Huntington	26	295	154	Newark	2	9
[illegible]	Pine	1	42	156	Hot Creek	2	5
55	Carico Lake	2	16	172	Garden	4	15
56	Upper Reese River	16	108	173b	Railroad - North	6	46
[illegible]	Lower Reese River	5	60	174	Jakes -	1	7
134	Smith Creek	3	24	176	Ruby	15	65
137b	Big Smoky - North	23	106	177	Clovis	9	36
138	Grass	4	22	178	Butte	2	10
139	Kobeh	1	8	179	Steptoe	17	93
140	Monitor	11	62	184	Spring	17	99
141	Ralston	1	5	205	Meadow Valley Wash	1	45
[illegible]	Stone Cabin	1	2	207	White River	4	37

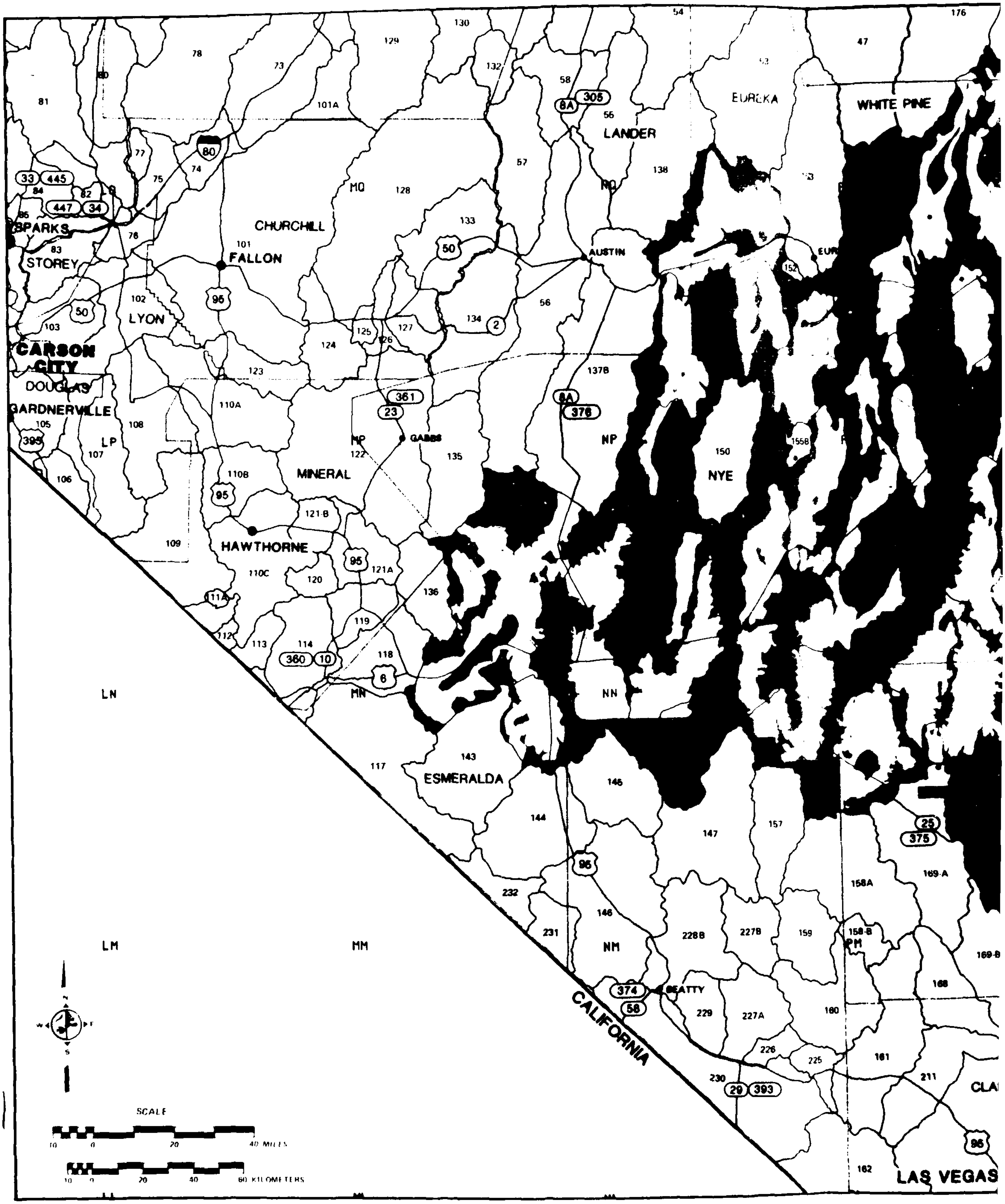
3092-1

Source: Wydoski , Berry, 1976. Nevada Stream Evaluation, 1977.

Table 3.2.3.8-20. Nevada gamefish harvest (effort and success).

YEAR	ANGLERS	DAYS	FISH	AVERAGE	
				DAYS/ANGLER	FISH/DAY
1976	227,688	1,374,484	3,363,595	6.03	2.44
1977	206,271	1,462,684	3,329,781	7.09	2.27
1978	178,684	1,657,295	3,752,800	9.28	2.26
1979	189,362	1,761,886	3,836,687	9.30	2.18

3923



WHITE PINE
EUREKA
LANDER
CHURCHILL
FALLON
AUSTIN
SPARKS
STOREY
LYON
CARSON CITY
DOUGLAS
GARDNERVILLE
MINERAL
GABBS
HAWTHORNE
NYE
ESMERALDA
BEATTY
CALIFORNIA
LAS VEGAS
SCALE
20
40 MILES
20
40
60 KILOMETERS

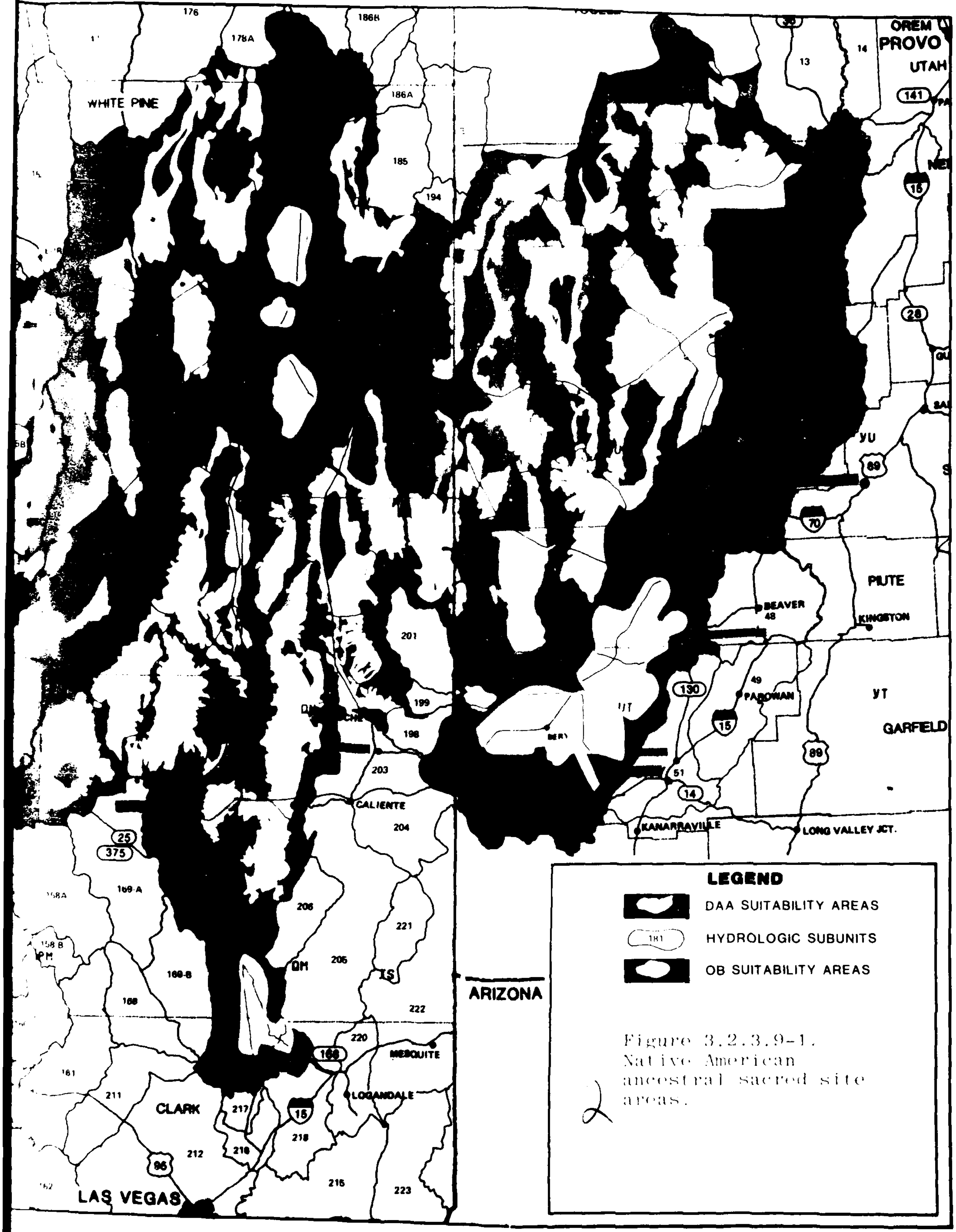


Figure 3.2.3.9-1. Native American ancestral sacred site areas.

3222-D

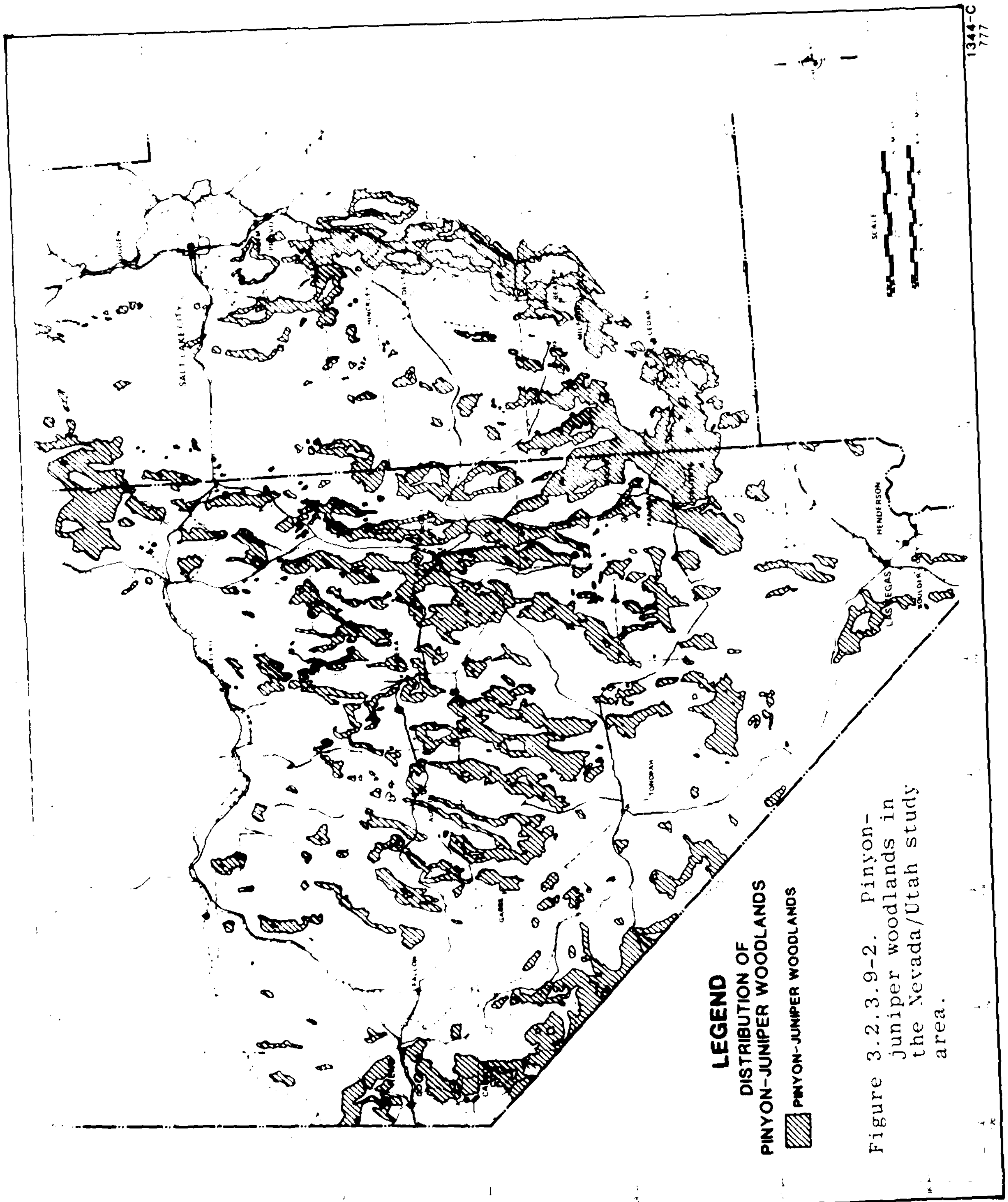


Figure 3.2.3.9-2. Pinyon-juniper woodlands in the Nevada/Utah study area.

Socioeconomic Environment (3.2.3.9.2)

Reservation Lands

There are over 2.5 million acres of Shoshone, Paiute, Washoe and Ute Indian reserve lands in the states of Nevada and Utah. Over 480,000 acres are within or adjacent to the area. The reservations and colonies, their associated populations and acreage, are listed in Table 3.2.3.9-1 and shown in Figure 3.2.3.9-3.

Withdrawal Lands

The Moapa Indians in southern Nevada proposed to withdraw 70,000 acres to the south and west of their reservation in the Garnet California Wash, Muddy River Springs, and Meadow Wash basins. The application is pending.

The Duckwater Shoshone propose to withdraw 352,000 acres or about 550 mi^2. The area corresponds to the acreage for which BLM grazing permits are held by the Duckwater Indians among other ranchers and lies in the Little Smoky north, central, and south and Railroad-northern hydrological units. The application is pending.

Treaty Lands

The Ruby Valley treaty of 1863 granted the Western Shoshone approximately 24 million acres of land. The treaty boundaries coincide with the Shoshone ancestral occupational areas shown in Figure 3.2.3.9-1. In 1951, the Indians claimed compensation for treaty lands lost to white settlers.

An Indian Claims Commission award of $26 million was refused by the Te Moak Band of Western Shoshone in 1974. The Te Moak petition for land restoration was denied by the Supreme Court in 1979.

The Moapa Southern Paiutes were given 3,900 mi^2 or 2,496,000 acres of reservation land by executive order in 1873. These lands lie in the southern tip region of Nevada. In 1874, a new executive order, superseding the first one, doubled the size of the land tract, but in 1875, Congress ordered that the reservation be reduced to 1,000 acres. The Moapa Indians are engaged in an effort to retrieve lands which were lost when the 1874 executive order was rescinded in 1875.

The status of Southern Paiute reservation lands in southern Utah is undetermined. In 1954, the Utah Southern Paiutes were terminated from federal trust status, but, as of 1980, "The Federal trust relationship has been restored..." (Public Law 96-227:317). The federal government has two years to develop its plan for the restoration and enlargement of reservations for the Utah Southern Paiutes.

Grazing Land

BLM grazing permits are held by Indians in the Duckwater, Odger's Ranch and Yomba grazing allotments.

The Duckwater Reservation Indians in central Nevada share BLM grazing permits with other ranches for about 352,000 acres of land in the Little Smoky and Railroad-northern valleys (Figure 3.2.3.9-4). The Odger's Ranch and Yomba allotments are outside the area.

Table 3.2.3.9-1. Vital statistics of Native American reservations and colonies in the Nevada/Utah study area and vicinity.

RESERVATION	COUNTY LOCATION	TRIBAL GROUP	ACREAGE[1]	DATE ESTABLISHED	POPULATION ESTIMATE	BIA AGENCY	TRIBAL HEADQUARTERS	TRIBAL GOVERNMENT MEMBERS[2]
Battle Mountain Colony	Lander (NV)	Shoshone	683	1917	171	E. Nevada	Battle Mountain, NV	6[3]
Duckwater	Nye (NV)	Shoshone	3,815[4]	1940-1944	124	E. Nevada	Duckwater, NV	6
Elko Colony	Elko (NV)	Shoshone	19[3]	1918	440	E. Nevada	Elko, NV	7[3]
Ely Colony	White Pine (NV)	Shoshone	103[5]	1931	187	E. Nevada	Ely, NV	5
Fallon and Fallon Colony	Churchill (NV)	Shoshone/ N. Paiute	8,240	1917	669	W. Nevada	Fallon, NV	7
Goshute	White Pine (NV) /Juab (UT)	Goshute	109,013	1914	602	E. Nevada	Ibapah, UT	6
Las Vegas Colony	Clark (NV)	S. Paiute	10	1911	191	W. Nevada	Las Vegas NV	7
Lovelock Colony	Pershing (NV)	N. Paiute	20	1907	143	W. Nevada	Lovelock, NV	5
Moapa River	Clark (NV)	S. Paiute	1,186	1975	189	W. Nevada	Moapa, NV	6
Odger's Ranch	Elko (NV)	Shoshone	1,987[6]	1938	7	E. Nevada	-[3]	-[3]
Ruby Valley	Elko (NV)	Shoshone	120	1887	-[7]	E. Nevada	-[3]	-[3]
Skull Valley	Tooele (UT)	Goshute	17,444	1917	87	Uintah and Ouray	Fort Duchesne, UT	3
South Fork	Elko (NV)	Shoshone	13,050	1941	98	E. Nevada	Elko, NV	7[3]
Walker River	Churchill, Lyon and Mineral (NV)	N. Paiute	323,326	1871	930	W. Nevada	Schurz, NV	7
Winnemucca Colony	Humboldt (NV)	N. Paiute Shoshone	340	1917	25	W. Nevada	Winnemucca, NV	4
Yomba	Lander (NV)	Shoshone	4,718[8]	1937	192	W. Nevada	Austin, NV	7

3853

NOTE: The Kanosh, Cedar City, Koosharem/Richfield Indian Peaks and Shivwits Reservation Utah Southern Paiutes have recently been reinstated to federal trusteeship; their land base and enrollment is still open.

[1]Acreage rounded to the nearest whole number.

[2]Tribal government officials include the total number of officers and members.

[3]All matters regarding land are decided by the six-member Te-Moak Western Shoshone Tribal Council.

[4]Duckwater also holds up to 800,000 acres in BLM permits.

[5]Ely leases 10 acres from the county.

[6]Odger's Ranch also holds 40,000 acres in BLM permits.

[7]Combined population of South Fork, Ruby Valley, and Odger's Ranch is 145. Odger's Ranch has only 7; Ruby Valley had 40 residents in 1972.

[8]Yomba Reservation also holds 268,397 acres in BLM permits.

Sources: U.S. Dept. of the Interior, Bureau of Indian Affairs, Information Profiles of Indian Reservations in Arizona, Nevada, and Utah, 1978;

U.S. Dept. of Commerce, Federal and State Indian Reservations and Indian Trust Areas 1974

Facilitators, Inc., Preliminary Field Data, 1980.

Water

The Humboldt River flows through or is adjacent to the Lovelock, Winnemucca, Battle Mountain, and Elko Indian reserves. The South Fork of the Humboldt and its tributaries are principal sources of water for the South Fork and Ruby Valley reservations. The Reese River, which flows into the Humboldt in the Battle Mountain area, is the principal source of water for the Yomba Reservation through which it flows. The Muddy River is an important water source for the Moapa Reservation and the Walker flows through the Walker Reservation. The Sevier River and its tributaries are important to the Southern Paiutes in Utah (Figure 3.2.3.9-5).

In addition to major rivers and tributaries, there are numerous springs of varying sizes in the study area that are economically significant for reservation and colony Native Americans. There are also thousands of small streams and creeks flowing out of the mountain ranges, many of which are important water resources for Native Americans.

Throughout most of the Great Basin, the stream and creek flows are erratic and/or minimal. Much of the surface water, therefore, is not diverted and utilized but seeps into the ground. Wells are relied upon extensively by Indians and non-Indians for domestic, agricultural and other purposes and groundwater storage volumes are of central concern to the area inhabitants.

The federal water rights doctrine, established in 1908, holds that water rights were reserved for Native Americans on reservations when the reservation lands were set aside.

Archaeological and Historical Resources (3.2.3.10)

National and State Register Properties (3.2.3.10.1)

The National Register of Historic Places is the nation's official list of properties worthy of preservation for significance in American history, architecture, archaeology, and culture.

All historic and prehistoric properties listed on or pending nomination to the National Register are shown in Figure 3.2.3.10-1. In the Nevada study area, there are currently 45 properties listed on the National Register and 10 properties currently pending nomination or in preparation for nomination. In the Utah study area, there are currently 49 properties listed in the National Register and 6 properties pending nomination. Utah has a State Register of Historic Places (Figure 3.2.3.10-1). Nevada has only recently established a State Register, and there are no entries as yet.

Archaeological Resources (3.2.3.10.2)

Data from the Great Basin study area serve to document a diversity of past adaptive patterns during the past 10,000 years. It is generally thought that the earliest occupants emphasized use of resources that occurred in the vicinity of Pleistocene lakes and rivers. Climatic change resulted in a shift to a more desert-oriented adaptation whereby people followed a mobile annual round based on seasonal, scheduled harvesting of both plants and animals. In the southern Nevada

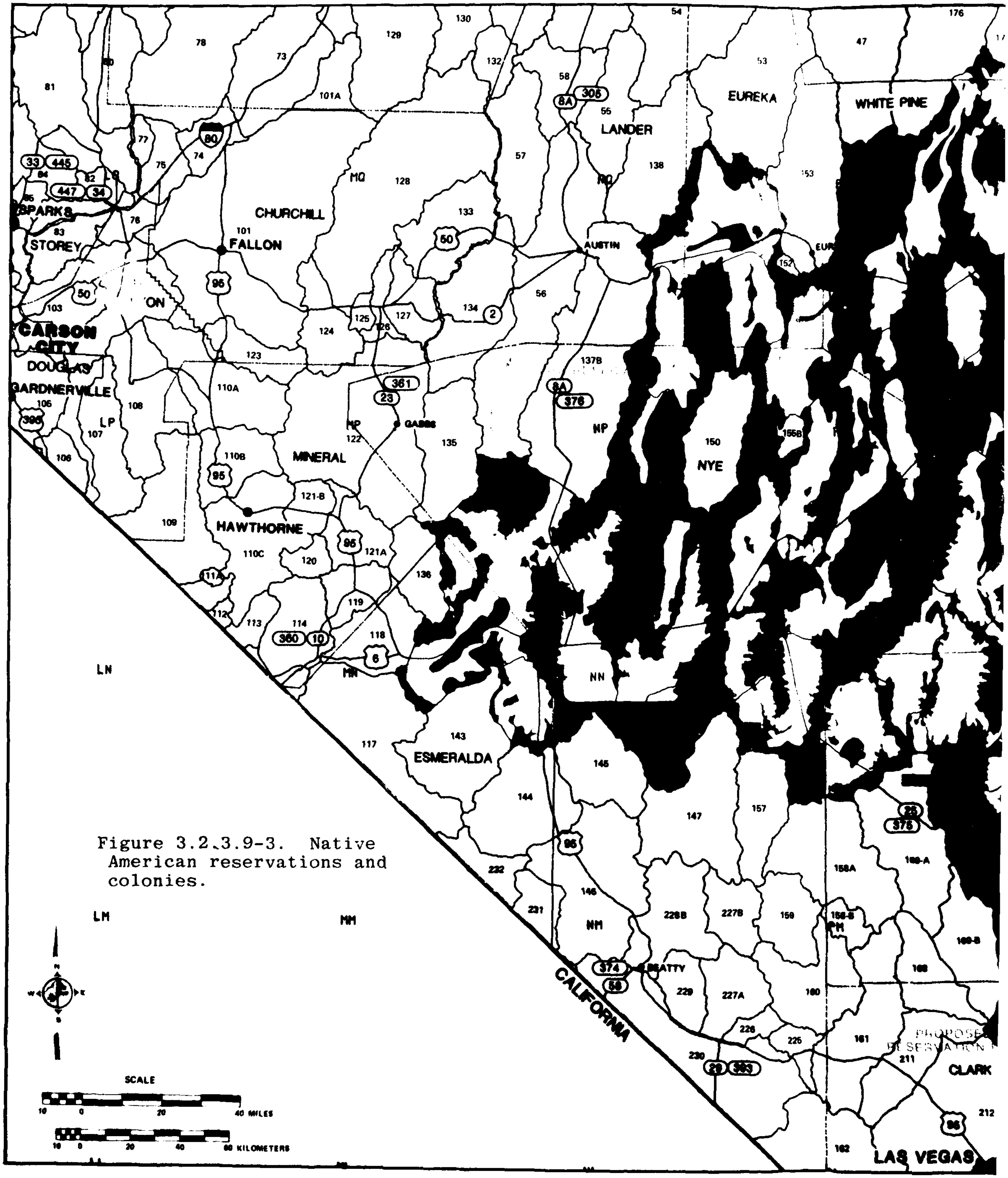
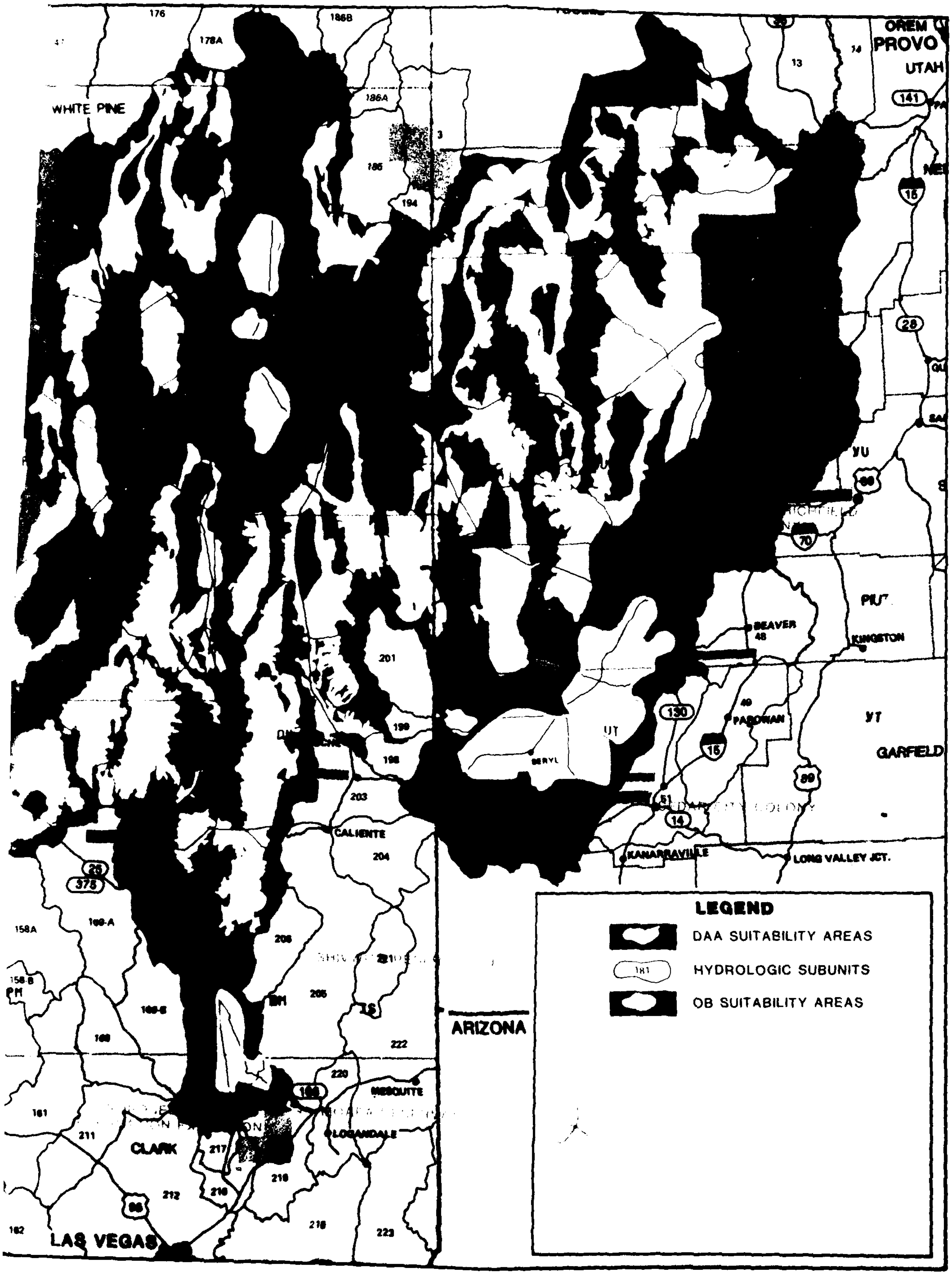


Figure 3.2.3.9-3. Native American reservations and colonies.


LEGEND
DAA SUITABILITY AREAS
HYDROLOGIC SUBUNITS
OB SUITABILITY AREAS
WHITE PINE
PROVO
OREM
UTAH
ARIZONA
CLARK
LAS VEGAS
CALIENTE
MESQUITE
LOGANDALE
BEAVER
KINGSTON
PAROWAN
GARFIELD
BERYL
KANARRAVILLE
LONG VALLEY JCT.

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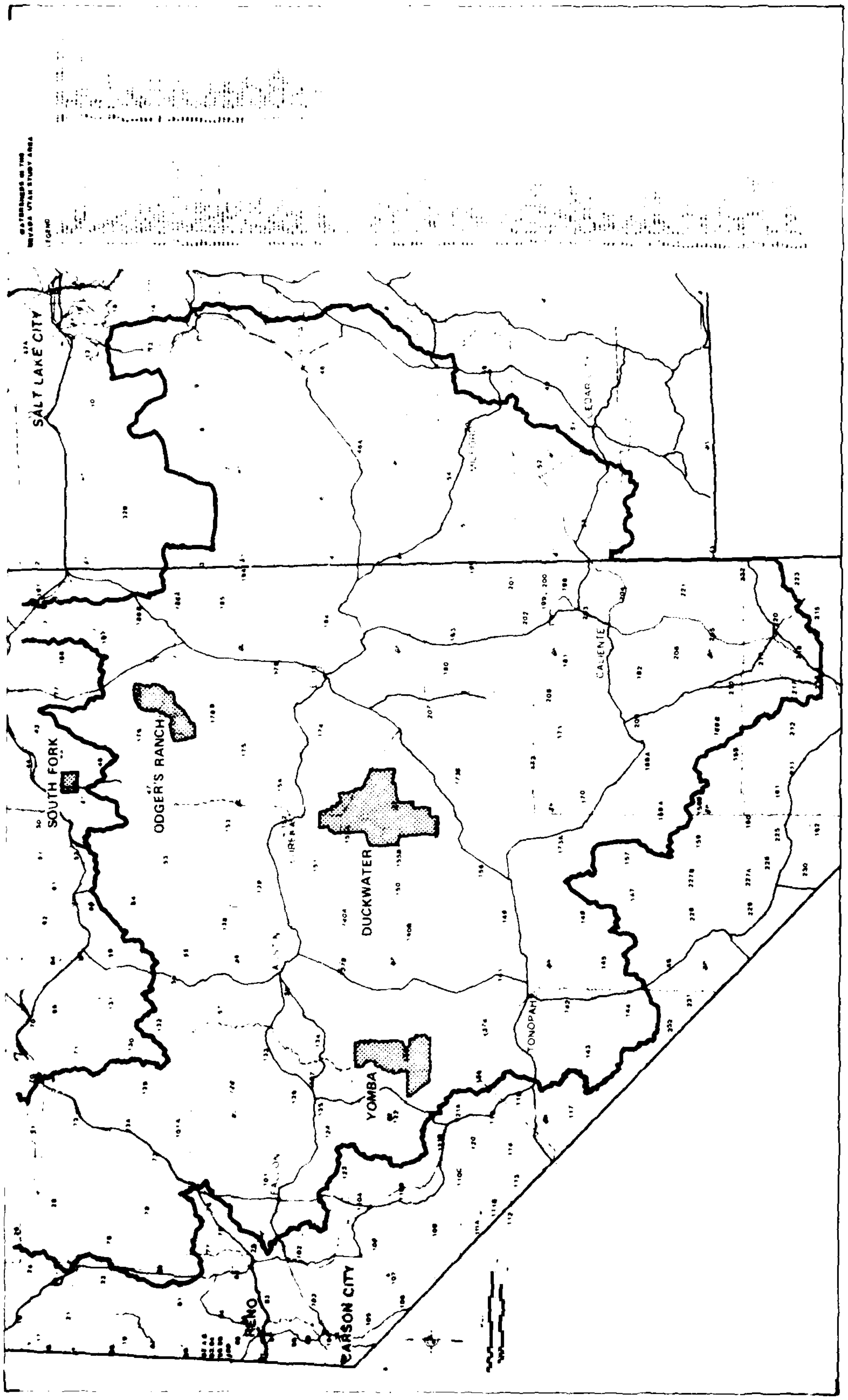

Figure 3.2.3.9-4. Native American BLM grazing allotments in the Nevada/Utah study area.

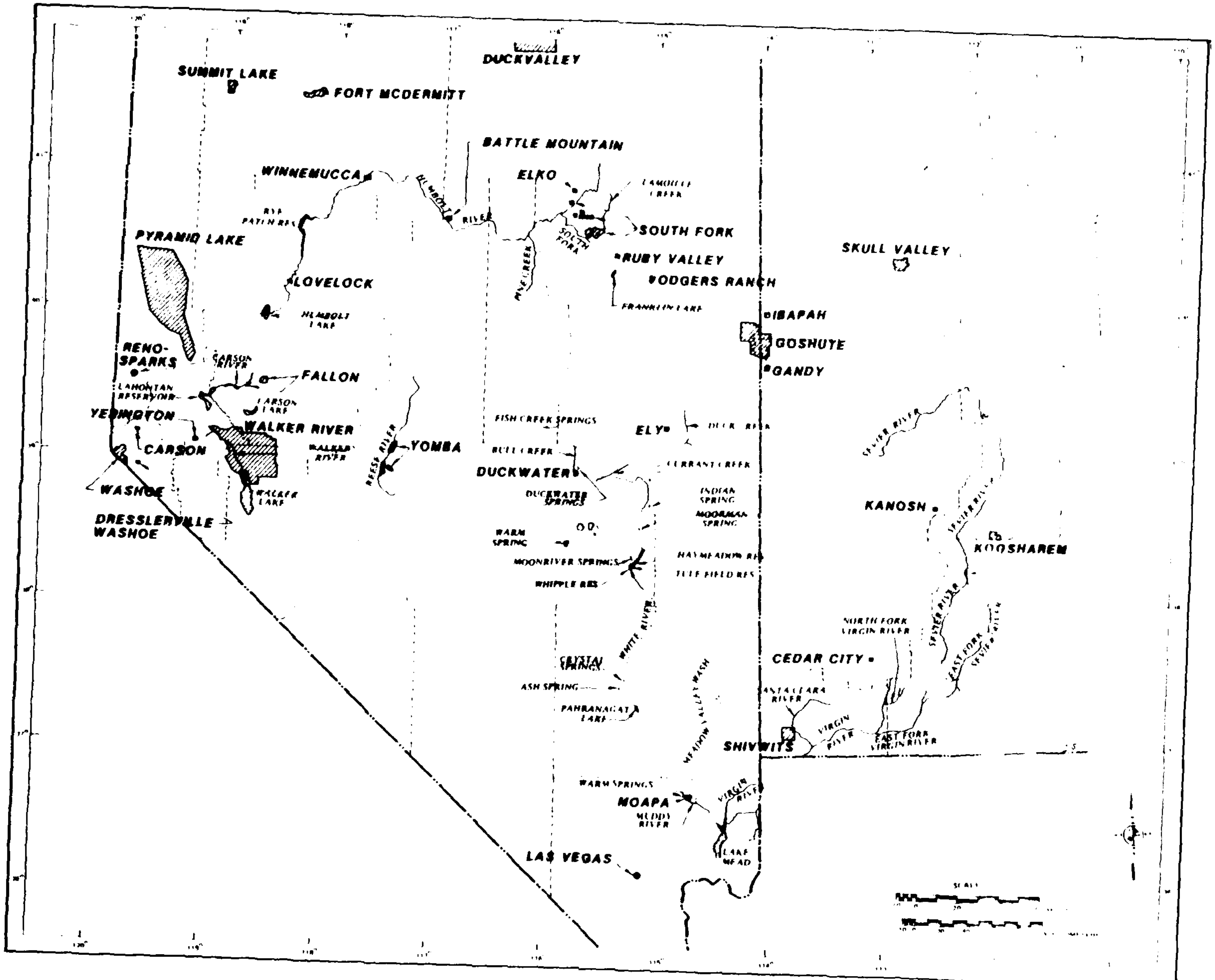

Figure 3.2.3.9-5. Important Native American water sources in Nevada/Utah study

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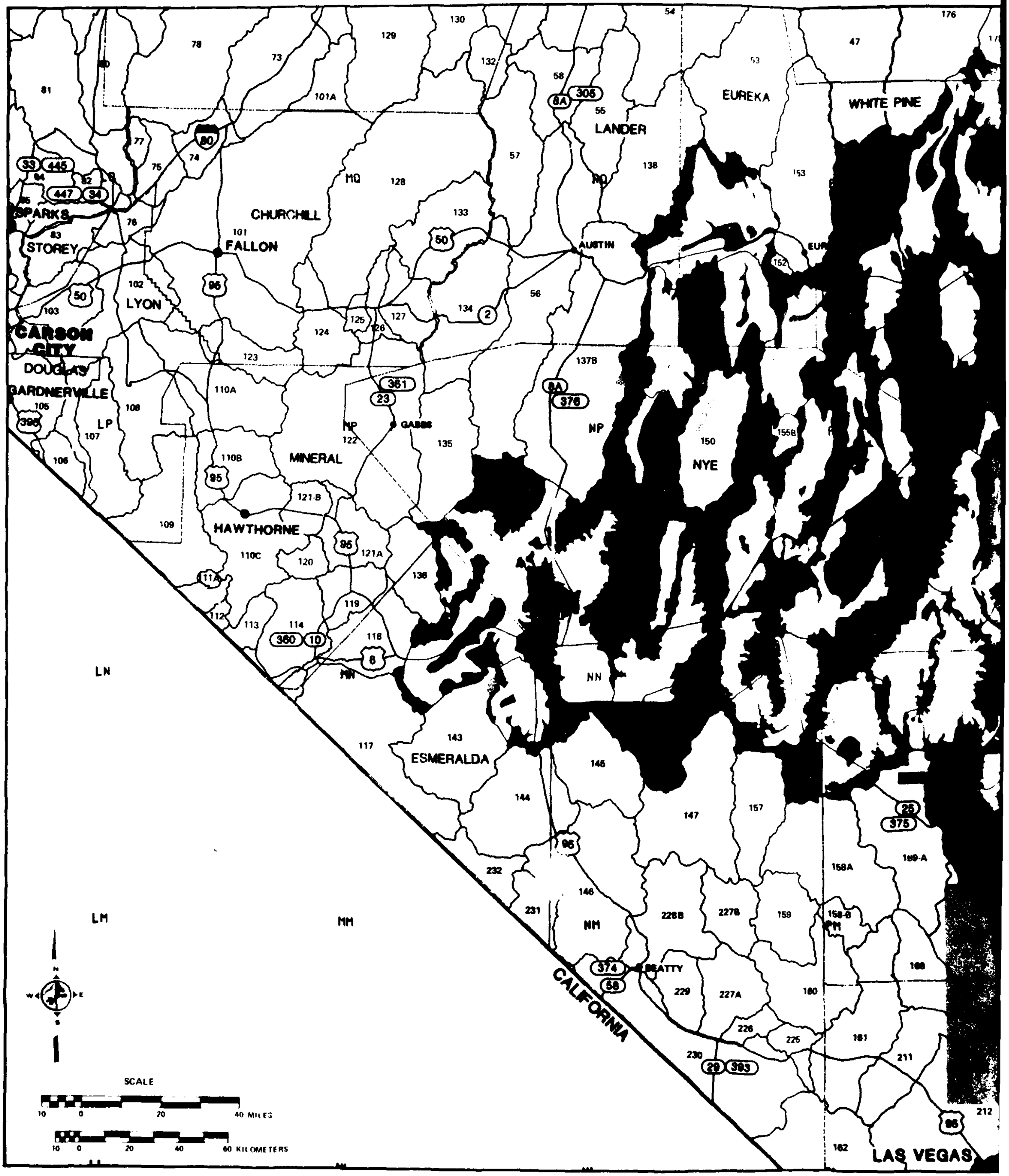

EUREKA
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LANDER
CHURCHILL
FALLON
SPARKS
STOREY
LYON
CARSON CITY
DOUGLAS
GARDNERVILLE
AUSTIN
GABBS
MINERAL
NYE
HAWTHORNE
ESMERALDA
BEATTY
LAS VEGAS
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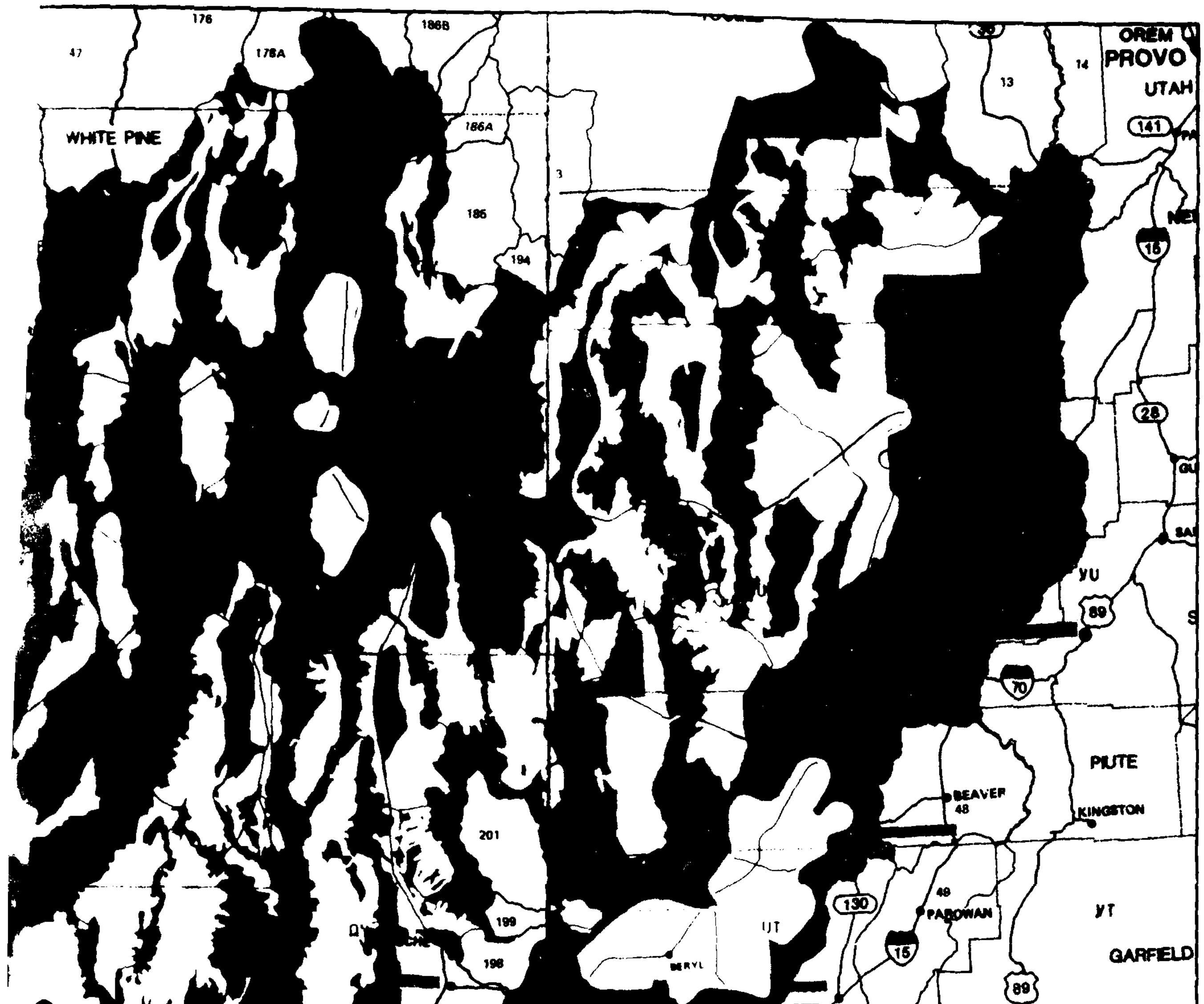


Figure 3.2.3.10-1. Archaeological and historical sites currently listed in the National Register of Historical Places.

3222-D

region, some farming and a more sedentary lifeway were practiced by the puebloan Virgin Branch Anasazi during the period between A.D. 400 and 1200. In Utah and in southeastern Nevada, Fremont peoples follwed a similar horticultural subsistence strategy and lived in semi-permanent villages. By A.D. 1000, Numic speaking groups apparently moved into the Great Basin following the Archaic pattern of seasonal movement and exploitation of wild food resources. During the same period, the Puebloan lifeways disappeared by A.D. 1200, perhaps as new peoples expanded into the region. Euroamerican settlement became significant only after the mid-1800s, with farming, ranching, and mining the principal economic activities.

The nature of the resources exploited by the past occupants of the study area had a strong determining effect on the nature and distribution of the material remains that now comprise the archaeological record. Data from nearly 2,000 archaeological sites from Great Basin watersheds have been classified into four major types of sites. "Multiple activity" sites generally include habitation sites such as seasonal campsites, rockshelters, homesteads, and mining camps. "Special purpose" sites are exemplified by rock art sites, cemeteries, churces, and battle grounds. "Limited activity" sites are those sites which either exhibit either short-term use or represent only a limited range of activities. Some examples of these sites include small lithic scatters, short-term campsites, isolated features, refuse dumps, corrals, and trails. "Isolated finds" can include any isolated artifact of human manufacture and/or use. Frequently, these include projectile points, flakes, ceramics, groundstone, bottles, and tin cans. Multiple activity, special purpose, and limited activity sites are likely to be eligible for inclusion in the National Register of Historic Places. Isolated remains, when considered in a regional context, have the research potential to answer scientific questions.

Existing data suggest that most site types tend to be associated with water and food resources; however, they can occur in any topographic setting. Limited activity sites and isolated finds are numerous and widespread.

Historical and Architectural Resources (3.2.3.10.3)

The historic resources in the Nevada/Utah study area reflect its settlement. Several historic exploration trails, numerous ghost towns, mining camps, homesteads, stage stations, railroad lines and stations, stamp mills, and ranches are present. Typically these resources can be expected near water sources and in the foothill and mountain zones. Nearly 1,800 historic sites have been identified within the study region. This area has undergone a series of economic booms, followed by periods of decline, and the architecture of cities and towns reflect these cycles. The most obvious remnants of these cycles are the numerous ghost towns.

Abandonment, neglect, and theft of materials have reduced the number of architecturally significant properties. However, the lack of intense development in small communities has helped preserve the architectural integrity of the now significant structures. Other architectural resources include residences, pony express and stage stations, military forts, and other isolated structures.

Paleontological Resources (3.2.3.10.4)

Paleontology in the Nevada/Utah region is divided into two basic types: those fossils of Paleozoic age, 225 to 590 million years, found in the mountain ranges, and those of Cenozoic age, 10,000 to 60,000 years, found mainly in the valleys and along the mountain fronts. Paleozoic fossils occur in most of the mountain ranges in Nevada and western Utah, except (a) those made up of Cenozoic volcanic rocks, and (b) the Snakes Range, which is largely metamorphic. Cenozoic fossil occurrences are scattered throughout the area. Figure 3.2.3.10-2 shows some of the known localities.

Construction Resources (3.2.3.11)

The M-X system will require substantial quantities of a number of construction resources to meet the needs of both direct and indirect construction activity. Those resources considered most significant and deserving of mention are cement, steel (mostly rebar steel), asphaltic oil, aggregate, and lumber.

Cement (3.2.3.11.1)

For a M-X system based in Nevada/Utah, the potential supply region covers the eleven western States. The levels of production for the eleven state regional market over the recent past are given in Table 3.2.3.11-1, reaching in excess of 17 million tons in 1978. Of this total, however, over 50 percent originates in California. Demand just exceeds production, however, regional output is considerably below present plant capacity levels with a capacity utilization for the region of 73 percent over the period 1973-1978. See Table 3.2.3.11-2.

At the more local level, however, demand exceeds capacity in both Nevada and Utah by 42 percent and 18 percent, respectively in 1979. Assuming the 11-state cement plant capacity utilization level of 73.7 percent over the period 1973-1978, these percentage shortfalls rise to 93 percent for Nevada and 60 percent for Utah. Over the period 1960-1978 the average regional shortfall has amounted to 105,000 tons/year.

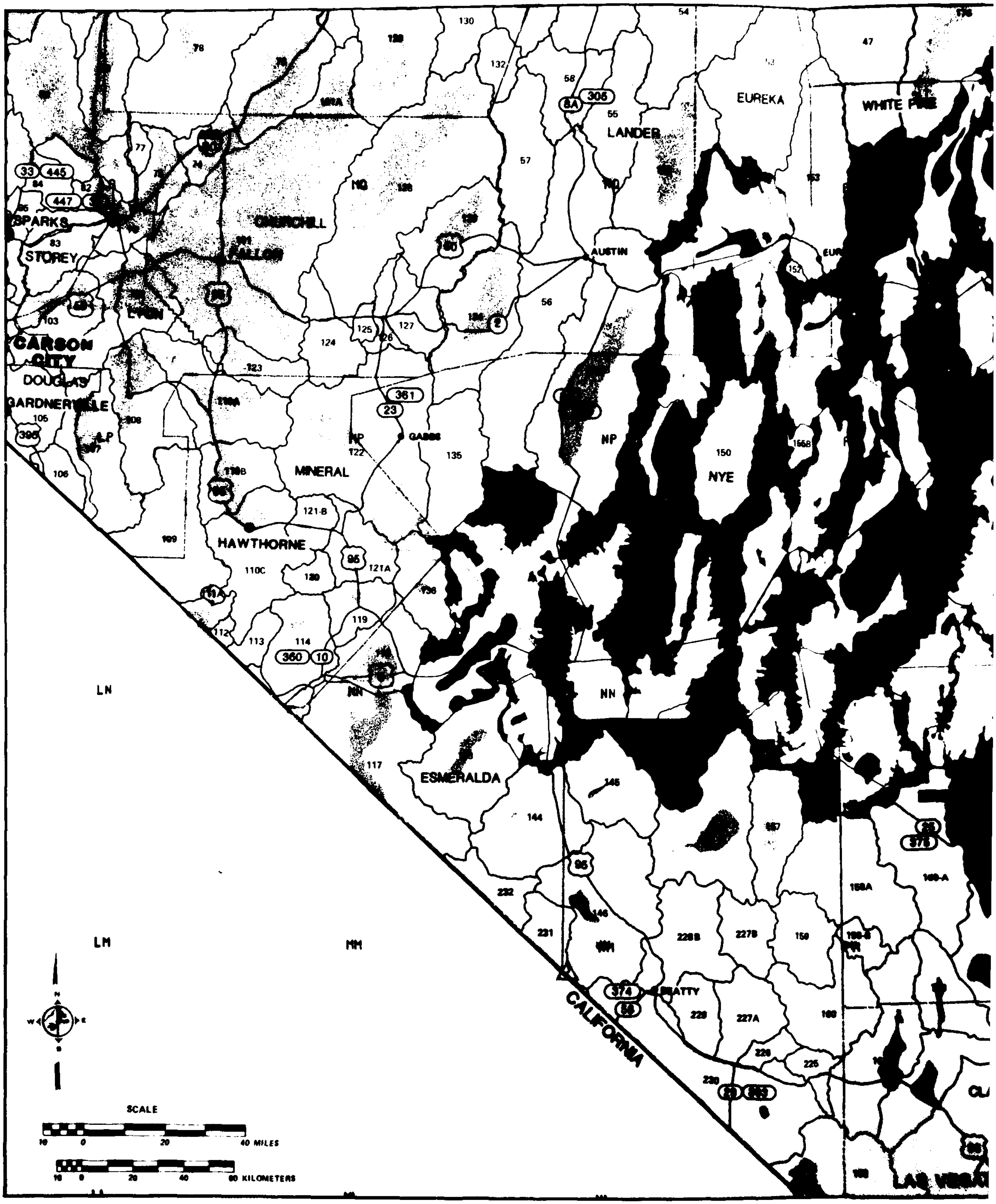
Steel (3.2.3.11.2)

Of all the steel utilized by the M-X system, 98 percent will be in the form of reinforcing bar steel (rebar) employed in reinforced concrete construction. The production of rebar takes place in plants much smaller in size than iron and steel plants and which are much more frequent in their geographical distribution. Producer of rebar exist in a number of states considered to be within the M-X supply region: California, Oregon, Wahsington, Utah, Arizona, and Colorado. Their combined estimated rebar capacity as of 1979 was over 1.5 million times annually which exceeds the regional consumption by over half a million tons.

Asphaltic Oil (3.2.3.11.3)

The demand for asphaltic oil originates in two sources: as a component of asphaltic concrete of which it makes up 5.6 percent by weight; and as road bed coating and realing oil.

Excess capacity presently exists within the regional supply area and two asphalt suppliers in southern California report that their combined capacity will be over four times the peak year requirements for M-X. Spokes people for the two companies indicated that the asphalt market is presently depressed due primarily to



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FALLON
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STOREY
LYON
CARSON CITY
DOUGLAS
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MINERAL
GABBS
HAWTHORNE
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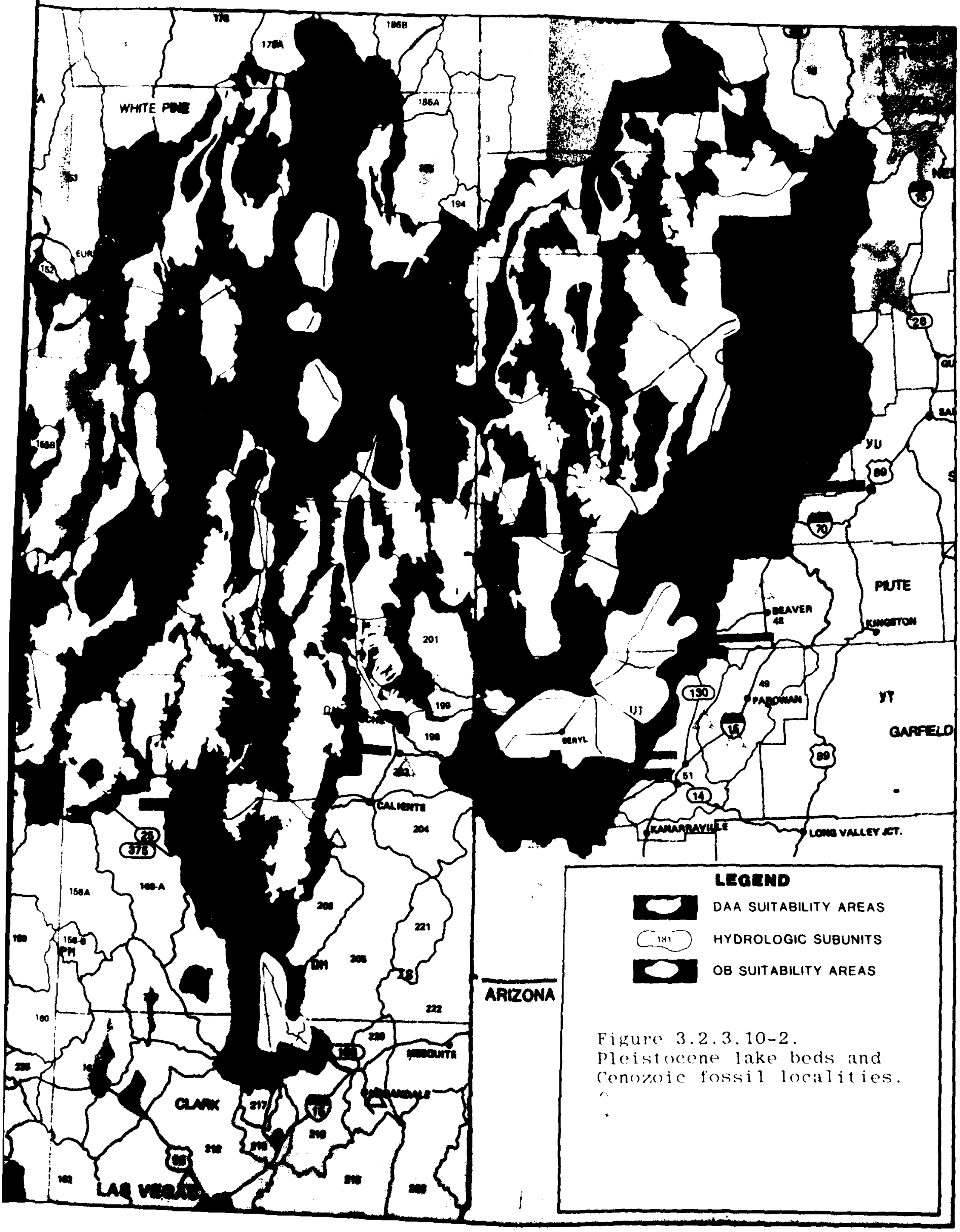

Figure 3.2.3.10-2.
Pleistocene lake beds and
Cenozoic fossil localities.

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Table 3.2.3.11-1. Nevada/Utah market area production of Portland cement by district, 1960-1978.

THOUSANDS OF SHORT TONS						
YEAR	WYOMING MONTANA AND UTAH	COLORADO ARIZONA UTAH AND NEW MEXICO	OREGON AND NEVADA	WASHINGTON	CALIFORNIA	TOTAL
	(1)	(2)	(3)	(4)	(5)	(6)
1960	490	2,238	-[1]	1,550[2]	7,498	11,776
1961	524	2,581	-[1]	1,393[2]	7,738	12,236
1962	576	2,550	-[1]	1,352[2]	8,239	12,717
1963	680	2,549	-[1]	1,460[2]	8,664	13,353
1964	685	2,413	-[1]	1,550[2]	9,022	13,670
1965	677	2,222	704	1,143	8,491	13,237
1966	694	2,191	804	1,166	8,719	13,574
1967	655	2,063	638	1,106	7,905	12,367
1968	718	2,274	680	1,189	8,849	13,710
1969	880	2,262	657	1,189	9,542	14,530
1970	841	2,598	740	1,254	9,411	14,844
1971	941	2,954	840	1,324	9,105	15,165
1972	[illegible]	3,147	[illegible]	1,420	9,392	15,750
1973	1,047	3,441	908	1,462	9,502	16,360
1974	[illegible]	[illegible]	916	1,389	8,302	14,950
1975	[illegible]	3,295	858	1,379	7,211	13,748
1976	[illegible]	3,524	911	1,391	7,892	14,763
1977	1,118	3,858	904	1,630	9,046	16,556
1978	1,058	3,899	1,006	1,880	9,315	17,158

3709

[1] Production data for Oregon included in Washington's total; no production data for Nevada until 1965.

[2] Washington's production includes Oregon from 1960-1964.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook

Table 3.2.3.11-2. Portland cement capacity utilization Nevada/Utah market area, 1973-1978.

Year	Wyoming, Montana, and Idaho	Colorado, Arizona, Utah, and New Mexico	Oregon and Nevada	Wash-ington	California
1973	86.3%	72.4%	65.6%	64.7%	83.1%
1974	89.6	62.5	66.1	61.5	74.2
1975	83.1	57.9	61.9	65.0	65.3
1976	85.6	62.1	65.8	67.2	73.6
1977	93.2	71.7	65.2	78.0	82.0
1978	88.2	70.3	75.9	89.7	83.3
Six Year Average	87.7%	66.1%	66.8	71.0%	76.8%

3729

Source U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

a major change in federal transportation funding which has reduced highway construction significantly.

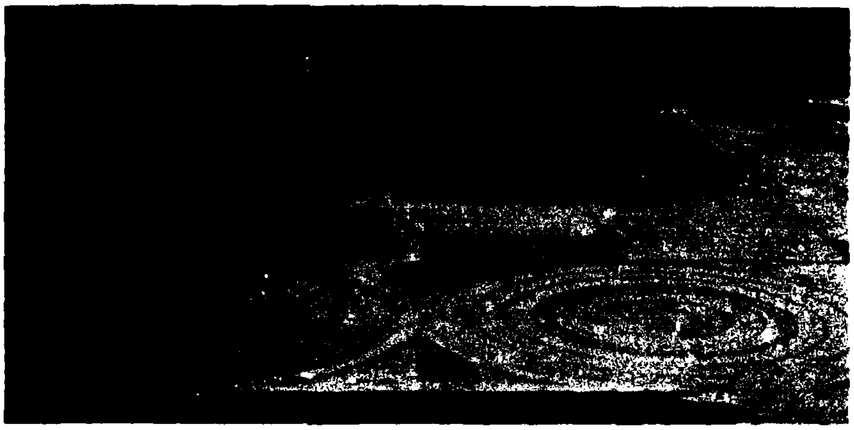
Aggregate (3.2.3.11.4)

Aggregate is virtually a ubiquitously occuring resource which, in addition, is transported only small distances because of both its low value and bulky nature. With M-X deployment in Nevada/Utah preliminary field reports indicate that basin fill is of good quality and that substantial recover exist throughout the deployment area.

Lumber (3.2.3.11.5)

M-X peak year demand for lumber amounts to 0.3 percent of national production and at present western lumber inventories and mill capacity are in excess of demand. The demand level exerted by M-X related construction can be considered no more than round-off error in production estimates.

Texas/New Mexico Regional Environment



REGIONAL ENVIRONMENT TEXAS/NEW MEXICO

INTRODUCTION (3.3.1)

The following sections describe the natural and human environment of the Texas/New Mexico study area. Included are descriptions of physical and biological resources: Groundwater; Surface Water; Air Quality; Mining and Geology; Vegetation and Soils; Wildlife; Aquatic Species; Protected Species; and Wilderness and Significant Natural Areas. Discussion of the human environment covers: Employment; Income and Earnings; Public Finance; Population and Communities; Transportation; Energy; Land Ownership; Land Use; Native American Resources; Archaeological and Historical Resources and Construction Resources.

General Descirption of Study Areas (3.3.1.1)

The study area in the Southern High Plains encompasses the Texas Panhandle and eastern New Mexico (Figure 3.3.1.1-1). The relatively flat land has no well-defined drainage basins and little runoff. The climate is semi-arid, precipitation averaging less than 20 in./year. Dry land and irrigated farming is an important economic activity. Several high-production oil and gas fields are within the area.

Description of Other Projects (3.3.1.2)

The effects of future projects will depend both on their geographic location within the region and their magnitude. To assess project impacts, it is necessary to simulate the future baseline environment. Also, since much of the project effects are driven by labor in-migration, future baseline employment levels must be detailed.

Table 3.3.1.2-1 presents baseline employment forecasts, by place of residence, for counties comprising the Texas-New Mexico ROI. These projections, an extrapolation of employment growth trends over the 1967-1977 period, indicate modest growth in regional employment through 1994. Over the 1982-1994 period, regional employment is forecast to increase by 38,590 jobs, an employment level of 343,450 in 1994 (HDR Sciences, October 1980).

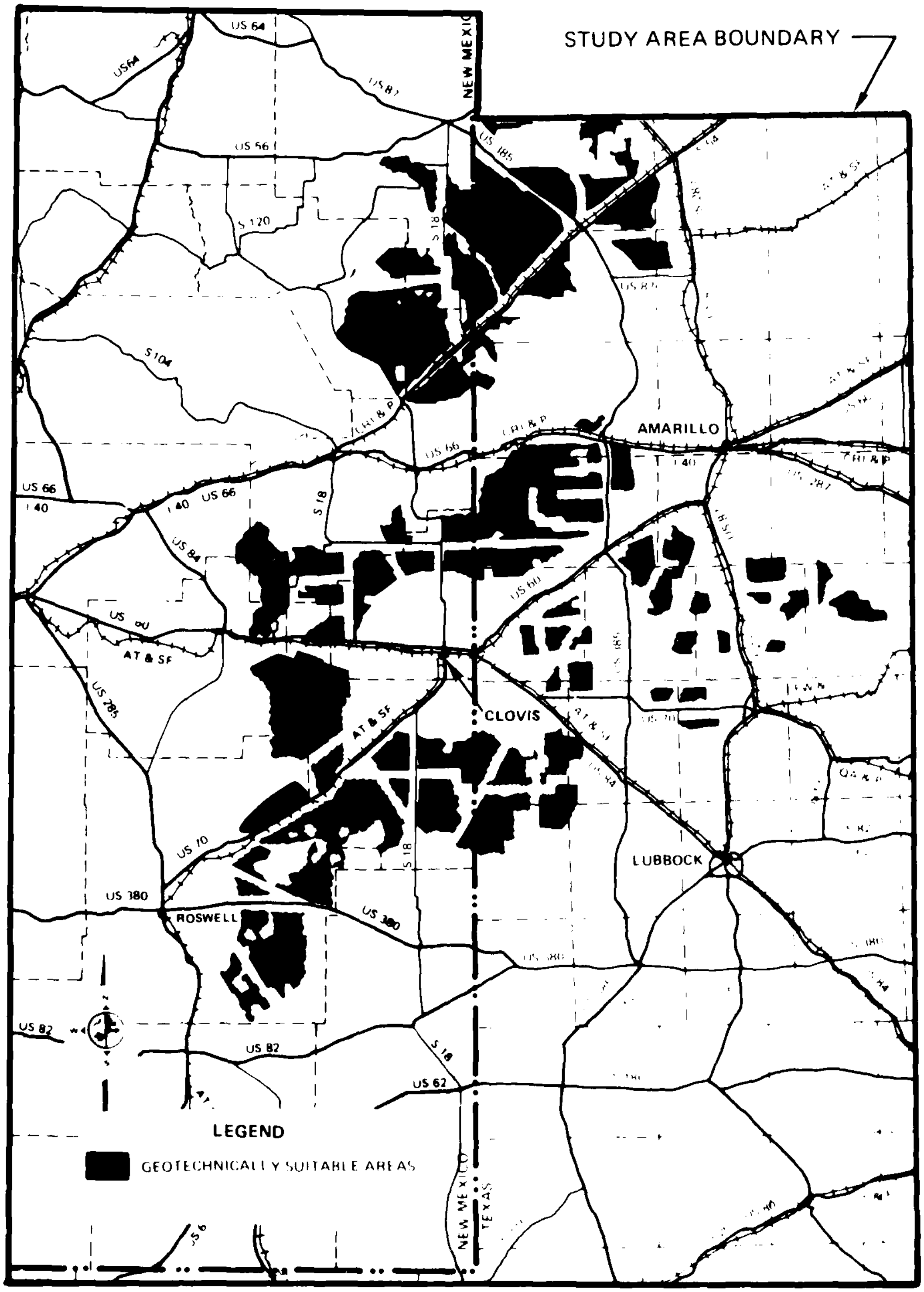


Figure 3.3.1.1-1. Geotechnically suitable areas in the Texas/New Mexico region currently under consideration.

Table 3.3.1.2-1. Employment by place of residence, including military, Texas/New Mexico region of influence, 1982-1994. (Page 1 of 2)

COUNTY	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
BAILEY													
BASELINE	3423	3432	3440	3452	3456	3465	3473	3481	3489	3493	3493	3493	3493
CASTRO													
BASELINE	4104	4119	4135	4154	4181	4212	4244	4275	4306	4344	4383	4422	4461
COCHRAN													
BASELINE	2092	2092	2092	2092	2092	2092	2092	2092	2092	2104	2120	2137	2153
DALLAM													
BASELINE	2234	2260	2286	2316	2339	2365	2391	2417	2446	2482	2521	2560	2600
DEAF SMITH													
BASELINE	8126	8183	8240	8301	8387	8476	8566	8655	8749	8851	8957	9062	9168
HALE													
BASELINE	15945	16113	16[illegible]	16456	16628	16799	16975	17155	17331	17553	17775	18001	18231
HARTLEY													
BASELINE	1157	1182	1207	1233	1258	1283	1309	1334	1359	1385	1410	1435	1461
BASELINE	9120	9170	9220	9271	9313	9355	9397	9439	9485	9537	9598	9657	9716
LAMB													
BASELINE	7127	7127	7127	7127	7115	7106	7090	7090	7082	7086	7086	7086	7086
LUBBOCK													
BASELINE	100427	101859	103313	104781	105976	107189	108407	109642	110892	112150	113422	114708	116008
MOORE													
BASELINE	6683	6711	6738	6770	6802	6839	6875	6912	6949	6974	7040	7086	7132
OLDHAM													
BASELINE	848	855	861	867	879	892	904	917	932	948	966	985	1004
PARMER													
BASELINE	4223	4223	4223	4223	4227	4235	4244	4252	4264	4293	4326	4358	4391
POTTER/RANDALL													
BASELINE	84373	85407	86461	87535	88548	89571	90615	91679	92763	93867	94992	96137	97302
SHERMAN													
BASELINE	1472	1480	1488	1495	1503	1511	1518	1526	1536	1549	1565	1580	1595

Table 3.3.1.2-1. Employment by place of residence, including military, Texas/New Mexico region of influence, 1982-1994. (Page 2 of 2)

SWISHER BASELINE	4544	4561	4578	4600	4630	4664	4670	4733	4767	4017	4870	4722	4774
[illegible] BASELINE	19502	19815	20136	20461	20749	21044	21343	21646	21952	22226	22500	227[illegible]	23050
CURRY BASELINE	14572	14619	14665	14712	14719	14725	14732	14737	14748	14719	14692	14665	14637
DE BACA BASELINE	985	985	985	985	974	966	959	951	947	947	947	947	947
HARDING BASELINE	523	513	503	498	484	474	464	454	444	424	404	384	364
QUAY BASELINE	4796	4805	4813	4822	4813	4805	4776	4788	4783	4762	4745	4728	4711
ROOSEVELT BASELINE	6463	6488	6511	6539	6566	6597	6628	6659	6694	6722	6753	6784	6815
UNION BASELINE	2119	2110	2101	2097	2101	2110	2119	2127	2141	2141	2141	2141	2141
TEXAS 17-COUNTY TOTAL BASELINE	255898	258774	261693	264673	267334	270050	272806	275599	278444	281457	284524	287629	290775
N M 7-COUNTY TOTAL BASELINE	48962	49335	49714	50114	50406	50721	51041	51364	51709	51941	52182	52426	52673
DEPLOYMENT REGION TOTAL BASELINE	304860	308109	311407	314787	317740	320771	323847	326963	330153	333398	336706	340055	343450

SOURCE HDR SCIENCES. 17-OCT-80

Over this period, Texas' share of the total forecast is to increase slightly, from 83.9 percent of total ROI employment in 1982 to 84.7 percent by 1994. This represents an overall average annual growth of 1.0 percent, with little cyclical fluctuation in employment on a year-to-year basis. The table indicates that not all counties are projected to grow; Lamb, DeBaca, Harding, and Quay counties are all forecast to experience minor employment loss. On the other hand, the counties of Lubbock and Potter/Randall, which already comprise relatively well developed economies, are forecast for above-average growth.

Trend growth includes the assimilation of some industrial expansion; however, sizeable energy projects, for example, would require adjusting employment growth forecasts. Numerous energy-related projects are slated for the region during the forecast period. However, virtually all have been found to be of a sufficiently small magnitude or short duration such that they would not be expected to alter trend-growth data presented in Table 3.3.1.2-1.

The following discussion details the more important future projects in the region. It sets out project employment requirements and compares them to projected available labor; then, where necessary, it estimates projected labor in-migration.

Labor in-migration is a key variable in assessing project effects, since it drives population in-migration, which in turn affects local housing markets as well as supplies of community goods and services such as health care facilities, police and fire protection services, parks, and other recreational facilities.

Tolk 1 and Tolk 2 Power Plants

The Southwestern Public Service Company is planning and building two large coal-fired electrical generating units in Lamb County, Texas. Each would have the capacity to produce 543 MW of electricity, with a capital cost of $220 million for each plant.

Construction of Tolk 1 is underway, and the unit should be on-line in mid-1982. Construction of Tolk 1 will require a peak of 650 workers in the spring of 1981. Construction of Tolk 2 will begin in 1982 and be completed in 1985. The Tolk 2 plant also will require a peak of 650 construction workers, with this peak occurring in the spring of 1984.

The build-up of operations personnel for Tolk 1 began in October 1980, and will reach a steady state of 100 to 120 persons by late 1981. Some operations personnel for Tolk 2 will start work in the fall of 1983, and will reach 30 by 1985. The total operating staff for both plants combined, therefore, is expected to be 130-150 people.

According to the manager of plant construction, few of the construction workers currently employed on Tolk 1 have their families near the site. Instead, most commute from their homes in Amarillo, Lubbock, Clovis, and elsewhere in the region. This pattern is likely to continue for construction of Tolk 2. Operations personnel probably would relocate to communities nearer the site, though the number of such persons is quite small.

Of the peak employment of 650 jobs, this analysis assumes that 100 would be filled by persons in Lamb County. If each of these direct jobs induces 0.5 indirect jobs in the county, the total employment impact in Lamb County would be 150 workers. The rest of the project's employment effects would be dispersed so widely over the region that no significant impacts in any single area are anticipated.

The Texas State Water Board's projected population of Lamb County during the 1980-1985 period is a constant 17,400 persons. Assuming a continuation of 1975-78 behavior for labor force participation and unemployment (an average participation rate of 42.8 percent and unemployment of 4.3 percent), projected employment (using the labor force concept) in the county would total 7,100 persons. Peak project employment of 150 persons represents 2 percent of this baseline projection. Most of the jobs created by the power plants could be filled by current residents of Lamb County projected to be unemployed, though some in-migration is likely because of possible mismatches between the occupational demands of the project and the skills of local-area residents.

To account for these small levels of project-induced in-migration, the "high growth" baseline for Lamb County is assumed to be 17,500 through 1995, compared to 17,300-17,400 projected under the trend growth baseline.

Interstate 27

The Texas Department of Highways and Public Transportation is planning major improvements to Interstate 27 over a 115-mi stretch from Amarillo to Lubbock. The project is broken into two sub-projects with the 24-mi section north of Swisher County managed from the Amarillo office and the remaining 91-mi portion managed from the Lubbock office. Both sections now are under construction, with approximately 100 workers employed on the Amarillo portion and 200 workers on the Lubbock section. This work force of 300 persons is expected to continue activities through 1986, with a decline in project employment thereafter, and completion anticipated in 1988-89. No significant numbers of operations personnel are associated with the project.

These project labor demands are extremely small compared to the size of the labor force in the Amarillo and Lubbock SMSAs. No adjustments are made to the baseline projections to account for this project.

Amoco Carbon Dioxide Pipeline

The Amoco pipeline project is designed to bring carbon dioxide from wells in Colorado to the Texas/New Mexico area. It would traverse Union, Harding, Quay, Curry, and Roosevelt counties in the M-X deployment region. The carbon dioxide delivered by the pipeline would be used for tertiary recovery of crude oil, a process that has been tested on an experimental basis but not yet applied commercially. The Amoco project bears a capital cost of approximately $300 million.

Construction of the pipeline is expected to require approximately 6 months, and probably would start in the last quarter of 1983. The project would require two crews of 300 workers each, laying 15,000 feet of pipe daily for seven months to complete the planned 400-mi pipeline. The project's employment requirements consequently consist of about 600 workers during late 1983 and early 1984.

Assuming an employment multiplier of 1.75 for the five-county region through which the pipeline would be built, the project's 600 direct jobs would generate an additional 450 indirect jobs, for a total employment impact within the five-county area of 1,050 jobs.

Baseline population projections from the University of New Mexico's Bureau of Business and Economic Research indicate a population for the five-county area of 78,000 during this period. Projecting the region's 1975-78 average labor force participation rate of 39 percent and unemployment rate of 5 percent, baseline employment (labor force concept) in the five-county area would be about 29,000 persons in 1984. Project-related employment of 1,050 jobs represents 3.6 percent of this baseline projection.

Since much of the project is located within long commuting distance to Amarillo and Lubbock, many of the project's employees would reside in these metropolitan areas. If half of the 600 direct employees do so, a total of 750 jobs would be filled by residents of the five-county area. Assuming that 250 of these jobs are filled by area workers who otherwise would be unemployed, the remaining 500 jobs would be filled by in-migrants to the area. If the ratio of population to employment for these in-migrating workers is 2.3 (the U.S. average for 1979), the population of the five-county area would increase by 1,150 persons during 1983-84. This represents 1.5 percent of the area's baseline population. The population of each of the five counties traversed by the pipeline therefore is assumed to increase by 1.5 percent above the baseline projection during 1983 and 1984.

Shell-Mobile Carbon Dioxide Pipeline

Shell and Mobile plan to construct a pipeline to transport carbon dioxide across New Mexico in a northwest-southeast direction. A total of 10 New Mexico counties would be traversed by the pipeline. Within the region of influence of the M-X system, however, only Chavez and DeBaca counties would contain portions of the pipeline.

The pipeline would require 1,300-1,400 workers during the peak construction phase from April 1982 to June 1983. These workers would be spread over the ten-county area traversed by the pipeline. It is reasonable to assume that one crew of 300 persons would be employed in Chavez and DeBaca counties during 1982-83. If half of the crew lives in these counties, and if the ratio of total project-related employment to direct employment is 1.3, the project would generate about 200 jobs in Chavez and DeBaca counties. Projecting the 1975-78 average labor force participation rates and unemployment rates for these counties implies a level of employment in Chavez County of 19,800 and in DeBaca County of 1,000 in 1982-83. Pipeline-related employment would represent 1 percent of this two-county total.

Since the projected unemployment rate in Chavez County is 6 percent, many of the pipeline-related jobs could be filled by area workers who otherwise would be unemployed. The small number of remaining jobs generated by the project would be within the normal employment growth projected for Chavez County under baseline condit ons. As a consequence, no alterations are made to the baseline projections to account for this project.

Arco Carbon Dioxide Pipeline

Arco plans to build a pipeline to transport carbon dioxide across the potential M-X deployment region from north to south through Union, Quay, Curry, and Roosevelt counties. The cost of the pipeline is approximately $200 million, with a peak construction-personnel requirement of about 600 workers. The peak of construction activity would occur between the fall of 1982 and the fall of 1983.

The economic and demographic impacts of the pipeline would be very similar to those of the Amoco pipeline project discussed previously. The labor and materials demands of the two projects are similar, and both projects are located in the same area. Peak activity on the Arco pipeline is scheduled approximately a year earlier than that on the Amoco project. The baseline populations of the four affected counties consequently are increased by 1.5 percent in 1982-83 to account for the impacts of the Arco pipeline. For the four counties traversed by both pipelines, the projected 1983 population under high-growth conditions reflects the combined impacts of the two projects.

San Marco Coal Slurry Pipeline

The San Marco Pipeline Company plans to build a 900-mi coal slurry pipeline, 80 mis of which would cross Union County in the northeastern corner of New Mexico. At the peak of construction activity from fall 1984 through spring 1985, approximately 600 workers would be employed in building the pipeline.

If half of the projects direct employees reside in Union County, and assuming the project has an employment multiplier within the county of 1.25, total employment creation in Union County as a result of the project is 375 jobs. Projecting into the future, the 1975-78 average labor force participation and unemployment rates of 45.6 and 4.2 percent, employment in Union County (labor force concept) would be approximately 2,100 persons. Project-related employment of 375 jobs represents 17.9 percent of this baseline projection.

Given the relatively low projected rate of unemployment, virtually all of the 375 workers would be in-migrants. If the average ratio of population to employment for these in-migrants is equal to the 1979 U.S. average of 2.3, the population impact of the project would be 860 persons. Since the peak of construction activity would be observed only during portions of 1984 and 1985, the annual average population impact would be somewhat less than 860 persons. Union County population is assumed to increase by 500 persons in 1984 and 750 persons in 1985 above trend-growth conditions as a result of the San Marco pipeline. In 1984, these impacts are added to the smaller impacts of the Amoco pipeline.

Table 3.3.1.2-2 summarizes the adjustments made to the baseline projections of the University of New Mexico's Bureau of Business and Economic Research and the Texas State Water Board in order to account for the likely effects of major non-M-X projects.

Table 3.3.1.2-2. Adjustments to baseline population projections to account for major non-M-X projects, Texas/New Mexico deployment regions.

COUNTY AND PROJECT	1982	1983	1984	1985
Lamb County, TX				
Trend-growth Baseline	17,400	17,400	17,400	17,400
Impact of Tolk 1 and 2	100	100	100	100
High-growth Baseline	17,500	17,500	17,500	17,500
Curry County, NM				
Trend-growth Baseline	43,870	44,010	44,150	44,290
Impact of Amoco	—	660	660	—
Impact of Arco	660	660	—	—
High-growth Baseline	44,530	45,330	44,810	44,290
Harding County, NM				
Trend-growth Baseline	1,050	1,030	1,010	1,000
Impact of Amoco	—	15	15	—
High-growth Baseline	1,050	1,045	1,025	1,000
Quay County, NM				
Trend-growth Baseline	11,230	11,250	11,270	11,290
Impact of Amoco	—	170	170	—
Impact of Arco	170	170	—	—
High-growth Baseline	11,400	11,590	11,440	11,290
Roosevelt County, NM				
Trend-growth Baseline	16,610	16,670	16,730	16,800
Impact of Amoco	—	250	250	—
Impact of Arco	250	250	—	—
High-growth Baseline	16,860	17,170	16,980	16,800
Union County, NM				
Trend-growth Baseline	4,850	4,830	4,810	4,800
Impact of Armoco	—	70	70	—
Impact of Arco	70	70	—	—
Impact of San Marco	—	—	—	—
High-growth Baseline	4,920	4,970	5,380	5,550

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Sources: Trend-growth projections are from the Texas State Water Board and the University of New Mexico, Bureau of Business and Economic Research. Impact estimates and high-growth projections have been calculated by HDR Sciences, October 1980.

Note: Only in Lamb County, TX, do the changes shown persist through the entire projection period (through 1994). For the other counties shown, no adjustments are made to the trend-growth baseline from 1986 through 1994.

NATURAL ENVIRONMENT (3.3.2)

Groundwater Resources (3.3.2.1)

All surface and groundwater in the project area originates from precipitation in Texas and New Mexico. Most of the precipitation returns to the atmosphere by evapotranspiration. The remainder appears as runoff in streams or percolates into the ground to recharge underground aquifers.

Rainfall occurs unevenly in the siting area, both seasonally and annually. In addition to being poorly distributed in space and time, most of the rainfall occurs within short periods of time. As a result, runoff is often excessive and damaging floods are frequent. Mean annual precipitation ranges from 15 to 20 in.

Like rainfall, snowfall in the area is poorly distributed from year to year. Average annual snowfall for the proposed siting area is 15 in.

The amount of lake surface evaporation is influenced by air and water temperature and wind movement over the surface of the water. During wet years when the availability of water is relatively high, net lake surface evaporation rates are low, but during years of drought, evaporation from lakes and transpiration rates of growing vegetation are high and the water supplies are increasingly depleted. Mean annual lake evaporation ranges from 60 to 70 in. per year.

Drought interrupts the flow of water supplies and increases the consumption requirements from water in storage. The water-supplying entities of the area must be prepared to store and deliver sufficient quantities of suitable-quality water to meet regular needs and to carry the water users through the drought cycle.

The principal aquifers in the project area are the Ogallala Formation on the High Plains of New Mexico and Texas and the shallow and artesian aquifers in the Roswell Basin, New Mexico. Numerous other geologic units are considered to be minor aquifers because of interior storage and production characteristics and water quality.

The Ogallala Formation (To) is the major aquifer in the project area. The boundary of the Ogallala Formation in the Texas/New Mexico area is shown in Figure 3.3.2.1-1 as are the counties affected by the proposed M-X project. The total volume of groundwater potentially recoverable from storage in the Ogallala Formation within the project area is approximately 112 million acre-feet. Of this total, approximately 100 million acre-feet is in storage in Texas. This is presented in Table 3.3.2.1-1. Average annual depletions from the Ogallala Formation are approximately 2 million acre-feet per year (see Table 3.3.2.1-2). The regions and subregions referred to in these Tables are illustrated in Figure 3.3.2.1-2.

The potential yields of wells that tap the Ogallala Formation generally exceed several hundred gallons per minute. The water quality is generally satisfactory for municipal and irrigation uses. Some groundwater contains objectionable concentrations of fluoride and hardness, and may require treatment before use.

Recharge to the Ogallala Aquifer is mainly from precipitation and has been estimated at a fraction of an inch per year (Cronin, 1969). Use of water from the

Ogallala Formation is mainly for irrigated agriculture. Relatively large users of the Ogallala aquifer for municipal supply in the project area include the cities of Clovis and Portales, and Cannon Air Force Base in New Mexico.

The artesian and shallow aquifer in the Roswell Basin make up a complex multi-aquifer system in which recharge to the groundwater almost equals removal of groundwater from storage. Production characteristics of the aquifers are excellent; yields of irrigation wells that tap artesian aquifers average 2,000 gpm. The quality of groundwater generally is satisfactory for irrigation and municipal uses; however, encroachment of saline water east of Roswell has occurred as a result of pumping. The aquifers of the Roswell Basin are used mainly for irrigated agriculture and for the City of Roswell's municipal supply.

The Dakota-Purgatoire Aquifer (Kdp) is an important aquifer in Regions II and V by virtue of its relatively good water quality and large volume of recoverable groundwater in storage. Projection characteristics of this aquifer are marginal for large-scale groundwater development. However, well yields of several hundred gallons per minute generally are possible where the Dakota-Purgatoire aquifer is overlain by the Ogallala Formation and wells tap both units. The principal water use from this aquifer is irrigated agriculture. The largest depletions of groundwater storage from the Dakota-Purgatoire aquifer are occurring near Clayton in Union County, New Mexico and in Northwestern Dallam County, Texas.

Nearly 4 million AFY of water were used in the project area in recent years. Of this total, nearly 90 percent was used for irrigated agriculture. In the ten Texas counties in the project area, surface water serves relatively few uses and therefore is not tabulated. Present and projected uses of groundwater in these Texas counties are shown in Table 3.3.2.1-3. Surface water is used extensively in some of the seven New Mexico counties in the project area. The present and projected uses of surface and groundwater in these New Mexico counties are shown in Table 3.3.2.1-4.

In the tabulation of water uses, a distinction is made between water use and water depletion. Water use is the quantity of water withdrawn from its source for a beneficial purpose. Water depletion is the proportion of the water withdrawn that is no longer available because it has been either evaporated, transpired, incorporated into products or crops, consumed by people or livestock, or otherwise removed from the water environment.

Water use demands are estimated for the years 1970 and 1980 and projected for the years 1990 and 2000 for all counties in Texas and New Mexico which contain candidate siting areas under basing modes currently being evaluated. The purpose of these projections is to characterize levels of competition for water which can be anticipated during the project life of M-X. The figures do not represent precise water use levels to be expected, because numerous economic, cultural, legal, and political changes could prevent actual use levels consistent with predicted demand. The figures represent a category-specific extrapolation of trends in water use which recently have been evident in the region. Both long-term trends and short-term variations were considered with long-term trends being the primary predictor of long-term projections, and short-term trends being the primary estimator of 1970 and 1980 demands. The projections do not reflect detailed interactions among competing use categories, a relationship which can significantly alter actual use levels. Decreases in high value uses such as steam electric generation or industrial

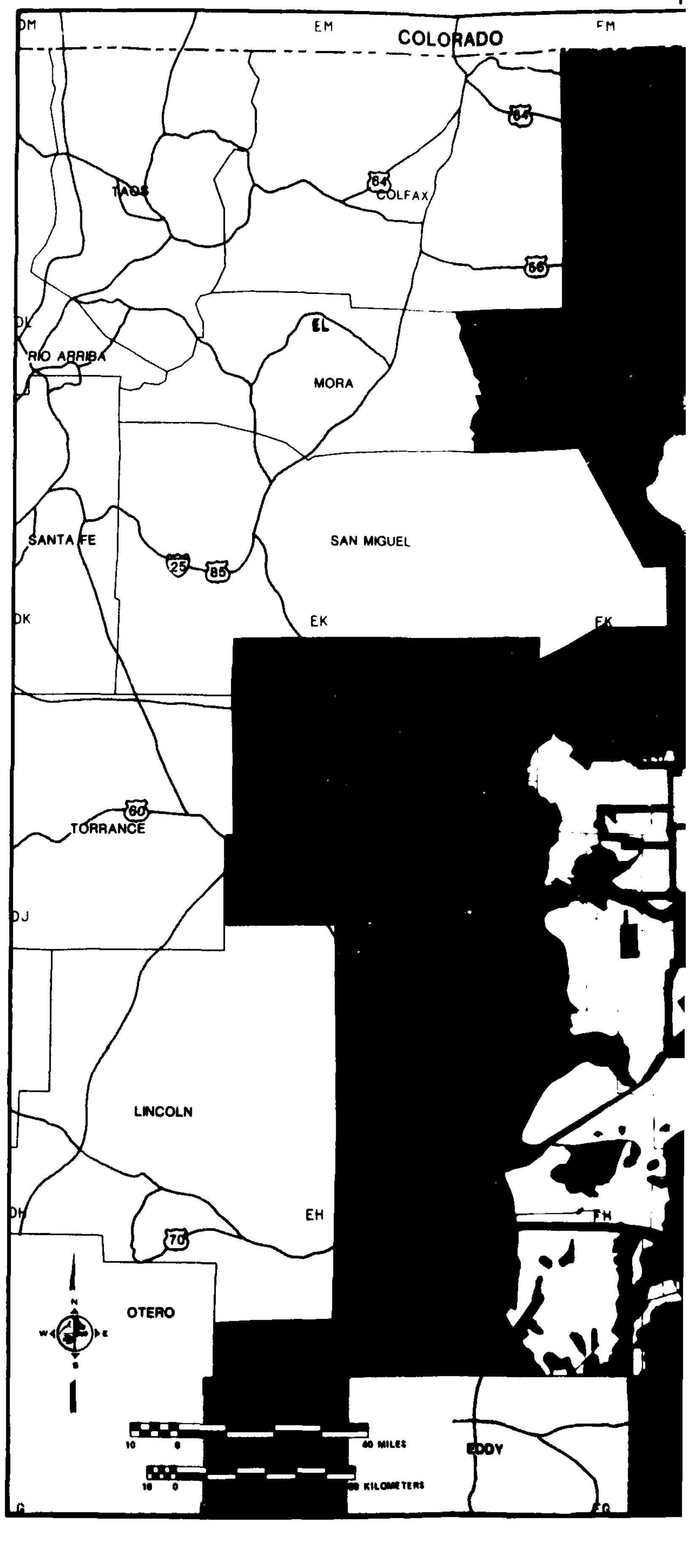
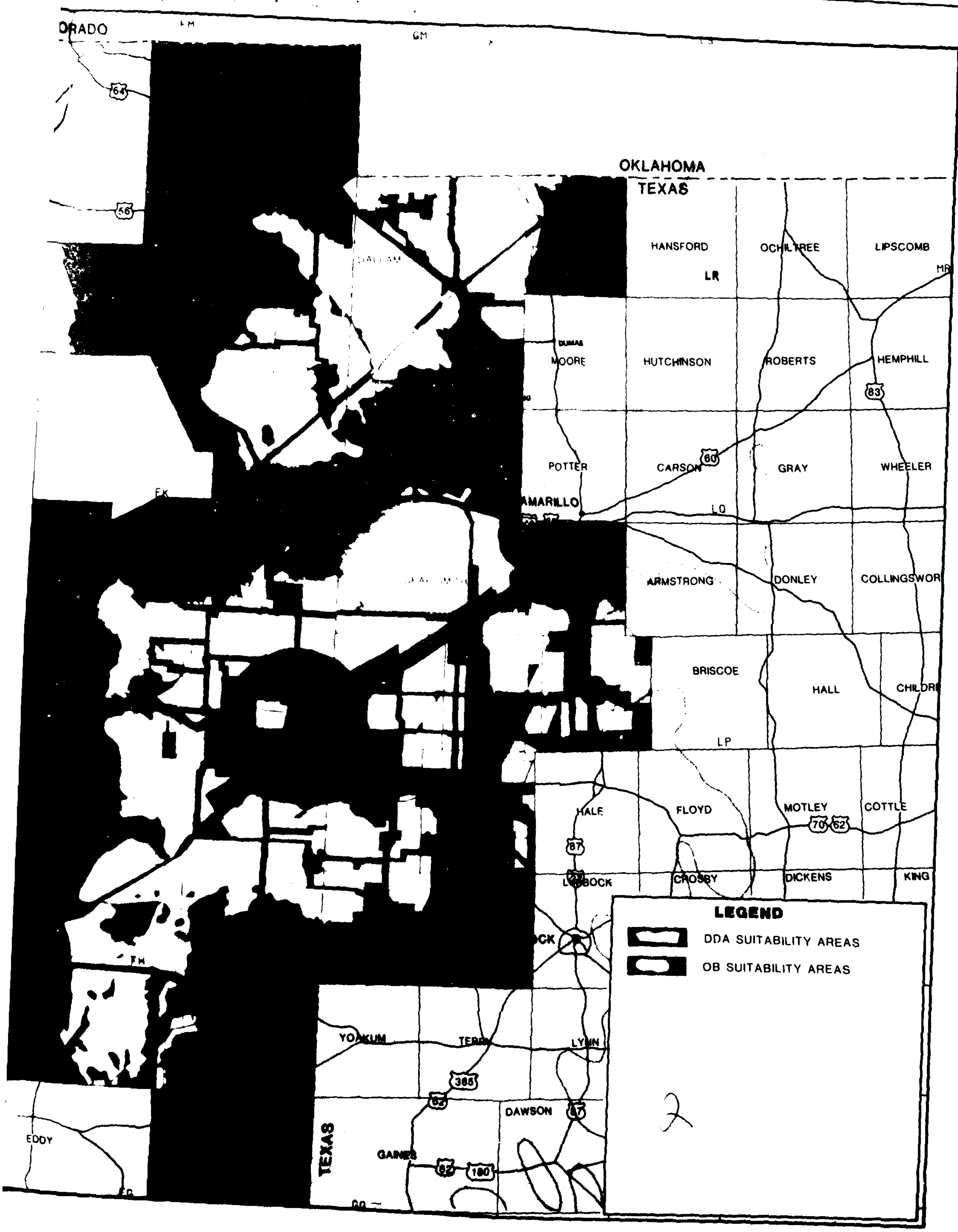


Figure 3.3.2.1-1 Boundary of the Ogallala Formation.



ORADO
OKLAHOMA
TEXAS
HANSFORD
OCHILTREE
LIPSCOMB
MOORE
HUTCHINSON
ROBERTS
HEMPHILL
POTTER
CARSON
GRAY
WHEELER
AMARILLO
ARMSTRONG
DONLEY
COLLINGSWOR
BRISCOE
HALL
CHILDR
HALE
FLOYD
MOTLEY
COTTLE
CROSBY
DICKENS
KING
YOAKUM
DAWSON
GAINES
TEXAS
EDDY
LEGEND
DDA SUITABILITY AREAS
OB SUITABILITY AREAS

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Table 3.3.2.1-1. Stored groundwater in regions.

REGION	SUBREGION[1]	AREA (ACRES)	SATURATED THICKNESS (FEET)	SPECIFIC YIELD	AVERAGE WELL YIELD (GPM)	VOLUME OF GROUND WATER IN STORAGE (10^3 ACRE-FEET)	RECOVERABLE GROUND WATER IN STORAGE[2] (10^3 ACRE-FEET)
I	Tc	—	—	0.15	500	—	26,100
	Ket	—	50	0.10			--[3]
II	—	—	—	—	200	—	49[illegible]
III	Tc	—	—	0.15	700	—	[illegible]
	Kap	—	—	0.10	100		--[3]
IV	shallow	—	—	—	500	—	[illegible][4]
	artesian	—	—	—	2,000	—	164[4]
V	Tc-e	85,760	25	0.15	250	322	[illegible]
	Tc-f	566,960	75	0.15	550	6,400	[illegible]
	Tc-g	344,320	20	0.15	200	1,030	[illegible]
	Tc-h	243,840	25	0.15	250	914	[illegible]
	Tc-i	41,410	25	0.15	250	155	[illegible]
	Kap-a	636,080	110	0.10	95	7,020	4,680
	Kap-b	384,000	100	0.10	100	3,840	2,560
	Kap-c	237,440	70	0.10	100	1,660	[illegible]
	Kap-d	211,120	50	0.10	100	1,060	[illegible]
	Kap-e	131,560	90	0.10	100	1,180	[illegible]
	Kap-h	273,920	100	0.10	100	2,74[illegible]	1,83[illegible]
	Kap-i	201,960	40	0.10	100	804	536
VI	Ka-a	109,070	50	0.10	100	545	36[illegible]
	Je	61,980	105	0.23	125	2,000	1,33[illegible]
	Trc-a	825,27[illegible]	110	0.10	10	9,060	6,040
	Trc-b	996,48[illegible]	90	0.10	15	8,970	5,98[illegible]
VII	—	—	—	0.15	500	8,670	5,780
VIII	Tc	211,760	25	0.15	250	800	1,250
	K	211,760	50	0.10	500	1,07[illegible]	1,470
IX	Qal-a	—	—	—	10	—	—
	Qal-b	—	—	—	1,000	—	—
	Qab	26,650	100	0.15	900	400	266
	Trc	—	—	—	<5	—	—
	Trs-a	—	—	—	<15	—	—
	Trs-b	—	—	—	500	—	—
	Pat	—	—	—	<10	—	—
	Psa (Pc)	—	—	—	<20	—	—

25n.

[1] The rock symbols for subregions are based on published reports.

[2] Regions I, II, III - published estimates.

[3] Values from the Ogallala Formation include contribution from this minor aquifer.

[4] Estimates of present pumpage in Region IV. Basin has substantial recharge; however, no new permits to pump ground water have been issued since 1960.

Table 3.3.2.1-2. Summary of calculations of depletion rates in ground-water regions.

REGION	SUBREGION[1]	METHOD[2]	DEPLETION RATE (AFY)	SOURCES
I	To Ket	A	796,000 (3)	Texas Water Development Board (1977); (see Table 2)
II	--	A	15,000	--
III	To Kdp	A	936,000 (3)	Texas Water Development Board (1977); (see Table 2)
IV	--	--	--	--
V	To-e	A	11,000	Hudson (1976)
	To-f	A,C	24,300	Hudson (1976); Sorensen (1974)
	To-g	A	7,700	Hudson (1976)
	To-h	A	44,300	Hudson (1976)
	To-i	D	200	Cooper and Davis (1967)
	Kdp-a	A	0	Hudson and Borton (1974); Hudson (1976)
	Kdp-b	A	0	Hudson and Borton (1974); Hudson (1976)
	Kdp-c	A	16,000	Hudson (1976)
	Kdp-d	D	2,000	Sorensen (1974)
	Kdp-e	A	5,500	Hudson (1976)
	Kdp-h	A	35,600	Hudson (1976)
	Kdp-i	D	2,000	Cooper and Davis (1967)
VI	Kd-a	D	400	Griggs and Hendrickson (1951)
	Je	E,D	1,800	Trauger and Bushman (1964)
	Trc-b	B,C	0	Bureau of Reclamation (1971); Sorensen (1974)
	Trc-e	C	20,500	Sorensen (1974)
VII	--	A,B	154,000	Hudson and Borton (1974); Sorensen (1977)
VIII	To-k	C	26,400	Blaney and Hansen (1965); Sorensen (1974)
IX	Dab	A	0	Mourant and Shomaker (1970); Hudson (1976)

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[1]Geologic symbols are based on published reports.

[2]Methods of calculating depletion rate (dV/dt) (see Section 5.3):

A. Rate (AFY) = (annual decline of water level) × (area) × (specific yield)

B. Rate (AFY) derived from pumpage data

C. Rate (AFY) = (amount of irrigation water minus amount of deep percolation) × (irrigated acreage)

D. Rate estimated using available data and professional judgment.

[3]Depletion rate for this minor aquifer is included in the value for the Ogallala Formation.

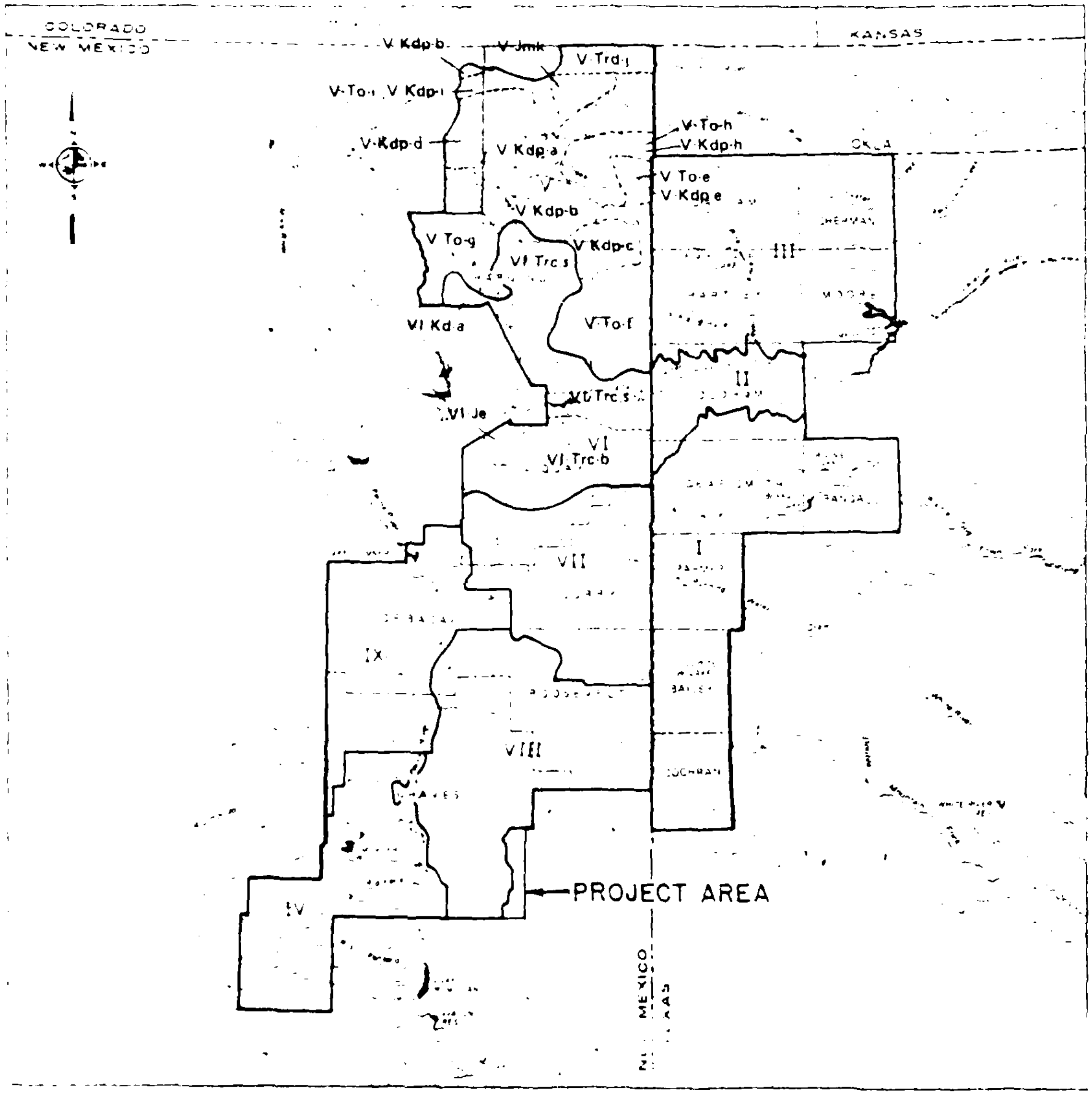

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Figure 3.3.2.1-2. Groundwater regions and subregions in the vicinity of the Texas/New Mexico study areas.

Table 3.3.2.1-3. Use and depletion of groundwater in Texas.

YEAR	REGION	WATER USE (acre-feet)	DEPLETION (acre-feet)
1974	I	1,074,600[a]	795,980[a]
	II and III	1,934,300[b,c]	—
1980	I	975,260[a]	717,100
	II	—	15,900
	III	—	935,500
2000	I	—	545,000
	II		3,500
	II and III	1,575,500[b,c]	
	III		830,500

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[a]Value for Randall County estimated as proportion of depletion in 1980 (Texas Water Development Board, 1977).

[b]Values reflect the sum of municipal and irrigation water uses from a summary of water use in the Canadian River Basin (Texas Water Development Board, 1977). Values are considered high because, in addition to the Project Area, Hansford, Ochiltree, Lipscomb, Hutchinson, and portions of Potter, Carson, Gray, and Hemphill Counties are included in the estimate.

[c]Regions II and III are undifferentiated because they are included together in the Canadian River Basin summary.

Source: Texas Water Development Board, 1977.

Table 3.3.2.1-4. Use and depletion of water in New Mexico.

YEAR	COUNTY	WATER USE (acre-feet)		WATER DEPLETION (acre-feet)	
		SURFACE	GROUND	SURFACE	GROUND
1975[a]	Chaves	46,583	288,051	32,513	187,260
	Curry	1,583	314,508	1,583	172,981
	De Baca	49,727	23,371	24,067	12,892
	Harding	2,629	9,661	2,629	5,413
	Quay	81,420	37,490	42,250	20,010
	Roosevelt	11,077	243,992	11,077	134,091
	Union	10,809	90,497	7,599	50,296
		(c)		(c)	
1980[b]	Chaves	332,500		217,400	
	Curry	299,700		170,200	
	De Baca	50,800		26,300	
	Harding	18,800		12,200	
	Quay	149,900		89,900	
	Roosevelt	184,900		115,700	
	Union	132,400		70,800	
2000[b]	Chaves	332,100		219,300	
	Curry	102,600		61,700	
	De Baca	46,800		26,700	
	Harding	25,600		17,200	
	Quay	16[illegible],500		102,100	
	Roosevelt	172,900		111,500	
	Union	146,300		84,000	

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[a] Source: Sorensen (1977).

[b] Source: "BEA-BBR 1972 projection" from New Mexico Interstate Stream Commission and New Mexico State Engineer Office, 1975, County Profiles, Water Resources Assessment for Planning Purposes.

[c] Combined value for surface and ground water.

uses often increase the market value of water in the region, thereby precluding its use for low value prediction such as marginal agriculture or livestock production. Furthermore, in designated valleys increased demands cannot be met by increased withdrawals. Withdrawals must remain essentially constant while demands rise. Rising demand is, in such cases, an expression not of the amount of withdrawal that will occur but rather of the economic stress in competition for water that can be expected in the area. Generally, increased demands beyond the level of withdrawal that can be achieved will be met by competition among existing uses. Since irrigation is normally the lowest value use, increases in other sectors will usually be met at the expense of irrigation agriculture and increasing demands in the irrigation agriculture sector will simply not be met.

Since irrigation agriculture normally accounts for greater than 95 percent of withdrawals and consumption, use levels in this category are by far the most important factor in determining future demands. In many counties, irrigation is increasing, and increased demands can be expected to cause problems of water availability during the project life unless mitigating measures or moderating influences reduce competing demands or increase supply. However, where irrigation is decreasing it is unlikely that surpluses in water availability will be generated by those declines. It is more likely that production costs associated with competition for water are already reducing the viability of marginal agricultural production thereby decreasing use levels. This problem does not preclude water use for M-X in any way, however, since M-X represents a high value use which can easily compete for water availability in a free market economy. It does suggest, however, that in many areas M-X uses will occur at the expense of irrigation agriculture or other low value uses.

Water use is characterized by two values, withdrawal volumes and consumption volumes. Withdrawals represent the amount of water displaced from the source and consumption represents that portion of withdrawal which is no longer available for other uses after the particular use has occurred. In general, water use is increasing slightly in the region and consumption is increasing slightly but at a faster rate than withdrawals. This is largely due to increased efficiencies in irrigation methods. Water withdrawal and consumption values were calculated using coefficient multiplication procedures similar to the accepted procedures used in national and regional assessments and projections of water demands. Activity levels and demand levels may differ from regional estimates due to the higher detail used in the county level estimates. Consumption values are generally estimated as an established percentage of withdrawal based upon observed, calculated, or published values. Tables 3.3.2.1-5 through 3.3.2.1-8 present estimates of current and projected water withdrawals and consumption in Texas and New Mexico through 2000.

Estimates of the physical availability of groundwater in the project area are presented in Table 3.3.2.1-9. For those subregions where value for "life of aquifer" is presented, mining (overdraft) of the groundwater reservoir (aquifer) is permitted by state laws. The life of the aquifer, therefore, corresponds to an estimate of the additional years that the groundwater reservoir can sustain present uses.

The "allowable additional development" assumes a 40-year life of the aquifer. It is the annual use in addition to existing uses that can be developed from the groundwater reservoir such that the reservoir is depleted in 40 years. This

Table 3.3.2.1-5. Texas water withdrawals (acre-feet/year).

COUNTY	1970	1980	1990	2000
Bailey	293,748	290,711	287,992	285,286
Castro	684,465	704,716	725,884	746,533
Cochran	261,325	252,248	243,289	234,532
Dallam	128,896	137,342	146,250	155,054
Deaf Smith	259,778	278,325	296,982	316,530
Hale	912,134	860,075	802,764	744,717
Hartley	86,406	97,823	106,650	115,636
Lamb	559,173	594,633	623,854	660,442
Moore	181,614	171,113	192,800	184,223
Oldham	28,341	31,111	32,877	34,505
Parmer	660,977	726,645	793,083	859,573
Swisher	547,340	578,495	607,246	636,227

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Table 3.3.2.1-6. Texas water consumption (acre-feet/year).

COUNTY	1970	1980	1990	2000
Bailey	247,420	245,345	243,553	241,702
Castro	595,581	613,399	639,415	650,964
Cochran	207,389	200,729	194,162	187,680
Dallam	104,526	111,647	119,353	126,940
Deaf Smith	209,852	224,828	239,667	255,407
Hale	791,021	742,309	690,708	639,258
Hartley	70,357	79,596	88,426	96,411
Lamb	483,441	515,431	567,883	601,009
Moore	141,694	135,796	129,335	124,200
Oldham	21,907	23,357	23,511	23,471
Parmer	574,575	632,282	690,816	749,451
Swisher	[illegible]	501,553	528,276	554,217

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Table 3.3.2.1-7. New Mexico withdrawals (acre-feet/year).

COUNTY	1970	1980	1990	2000
Chaves	396,831	407,484	420,121	432,523
Curry	256,421	281,024	306,088	330,934
De Baca	28,900	31,252	33,806	36,200
Quay	118,635	131,399	145,316	158,774
Roosevelt	131,256	159,629	187,637	217,699
Union	65,605	66,075	67,909	69,223

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Table 3.3.2.1-8. Consumption (acre-feet/year), New Mexico.

COUNTY	1970	1980	1990	2000
Chaves	244,458	252,039	261,739	271,315
Curry	185,681	203,389	221,633	239,683
De Baca	17,975	19,797	21,800	23,718
Quay	54,601	62,804	70,324	77,486
Roosevelt	95,450	116,356	137,519	159,487
Union	36,217	38,335	39,825	40,807

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Table 3.3.2.1-9. Physical availability of groundwater in the Texas/New Mexico study area.

REGION[1]	SUBREGION[2]	RECOVERABLE GROUNDWATER IN STORAGE (10^3 acre-feet)	DEPLETION RATE (10^3 AFY)	LIFE OF AQUIFER[3] (years)	ALLOWABLE DEVELOPMENT[4] (10^3 AFY)
I	To Kec[5]	28,100	796	35	[illegible]
II	—	490	15.9	31	[illegible]
III	To Kdp[5]	72,100	936	77	366
IV	shallow artesian	[illegible]	—	—	[illegible]
[illegible]	To[3]	215	11.0	19	[illegible]
	To[4]	4,270	24.3	175	82.4
	To[5]	687	7.7	89	9.5
	To[6]	609	44.3	14	[illegible]
	To[7]	103	0.2	515	2.4
	Kdp[1]	4,680	0.0	—	117
	Kdp[2]	2,560	0.0	—	64.0
	Kdp	1,110	16.0	69	11.7
	Kdp	707	2.0	353	15.7
	Jdc[3]	787	5.5	143	14.2
	Kdp[6]	1,830	35.6	51	10.2
	Kdp[7]	536	2.0	268	11.4
VI	Kd[1]	363	0.4	907	8.7
	Je	1,330	1.8	739	21.4
	Trc[4]	6,040	0.0	—	151
	Trc,s	5,980	20.5	292	129
VII		5,780	154	37	[illegible]
VIII	To [illegible]	1,250	26.4	47	4.6
IX	[illegible]	266	0.0	—	[illegible]

[1] Regions shown on Figure 3.3.1.3-2.

[2] Geologic symbols for subregions provided on Figure 3.3.1.3-2.

[3] Life of Aquifer = $\dfrac{\text{Recoverable Groundwater in Storage}}{\text{Depletion Rate}}$.

[4] Allowable Additional Development (?) assumes a 40-yr life of the aquifer:

(?) = $\dfrac{\text{Recoverable Groundwater in Storage}}{40}$ − Depletion Rate.

[5] Values of recoverable storage and depletion rate include contributions from both aquifers.

[6] Pumpage in Roswell Basin limited by State Engineer to present amount: approximately 104,000 AFY for shallow aquifer and 184,[illegible] AFY for artesian aquifer in Region IV.

[7] Additional development in the Portales Underground Water Basin is regulated by the New Mexico State Engineer.

[8] Subregion lies within Fort Sumner Underground Water Basin. Additional development probably not allowed unless [illegible] rights are retired.

additional groundwater development is assumed to be consumptive use, which probably would result from municipal and industrial use of the water for the proposed M-X project. Where the "life of aquifer" is less than 40 years, no additional develpment of the aquifer is assumed. The subregions with less than a 40-year "life of aquifer" are judged to have a severe problem of groundwater overdraft. Forty years is the life of the aquifer generally assigned by the New Mexico state engineer to declared underground water basins in which overdraft is permitted.

An interpretation of the estimates of physical availability of groundwater is as follows. For subregions in which "allowable additional development" is non-zero, development of groundwater, in addition to the amount presently being used, can take place. The relative size of that additional development is indicated by the values in Table 3.3.2.1-9. For subregions in which "allowable additional development" is zero, existing uses of groundwater would have to be retired in order to use groundwater for other purposes.

Reliance on Table 3.3.2.1-9 to predict the availability of groundwater must be qualified. First, in New Mexico, the state engineer may administer use of groundwater by declaration of an underground water basin. Parts of Regions IV, VII, and IX lie within such declared basins and are essentially closed to additional groundwater development. In the Portales underground water basin, use of relatively large quantities of groundwater would require the purchase of existing groundwater rights. In the Fort Sumner and Roswell underground water basins, use of groundwater probably would require the purchase of both groundwater and surface water rights. The dependability of groundwater rights in basins tributary to the Pecos River are in question because of the ongoing suit over the Pecos River Compact. In addition, the New Mexico state engineer may declare a new underground water basin in the project area if he feels management controls of groundwater use are necessary.

Secondly, in the Texas part of the project area, most of the land and, consequently, the water rights, is owned by individuals. Purchase of lease of the land and/or water rights would be required to develop the groundwater for municipal and industrial use for the proposed project M-X. In areas under the jurisdiction of underground water conservation districts, rules established by the respective districts regarding well spacing would have to be followed.

Thirdly, the values presented in Table 3.3.2.1-9 are for planning purposes only and should be used cautiously, especially in subregions where extensive development of groundwater has not taken place. In these relatively undeveloped subregions, published hydrologic data probably are not sufficient to reliably estimate the quantity of recoverable groundwater, potential well yields and other design factors, and the economics of obtaining a groundwater supply. In addition, the foregoing analysis has not considered uncertainties involved in the acquisition of land and/or water rights.

Surface Water (3.3.2.2)

The project area lies within parts of three major surface water drainage basins: (1) Arkansas-Red White River Basins, (2) Texas Gulf Basins, and (3) Pecos River Basins (Figure 3.3.2.2-1). The principal surface water resources in the project area are the Canadian River in New Mexico and Texas and the Pecos River in New

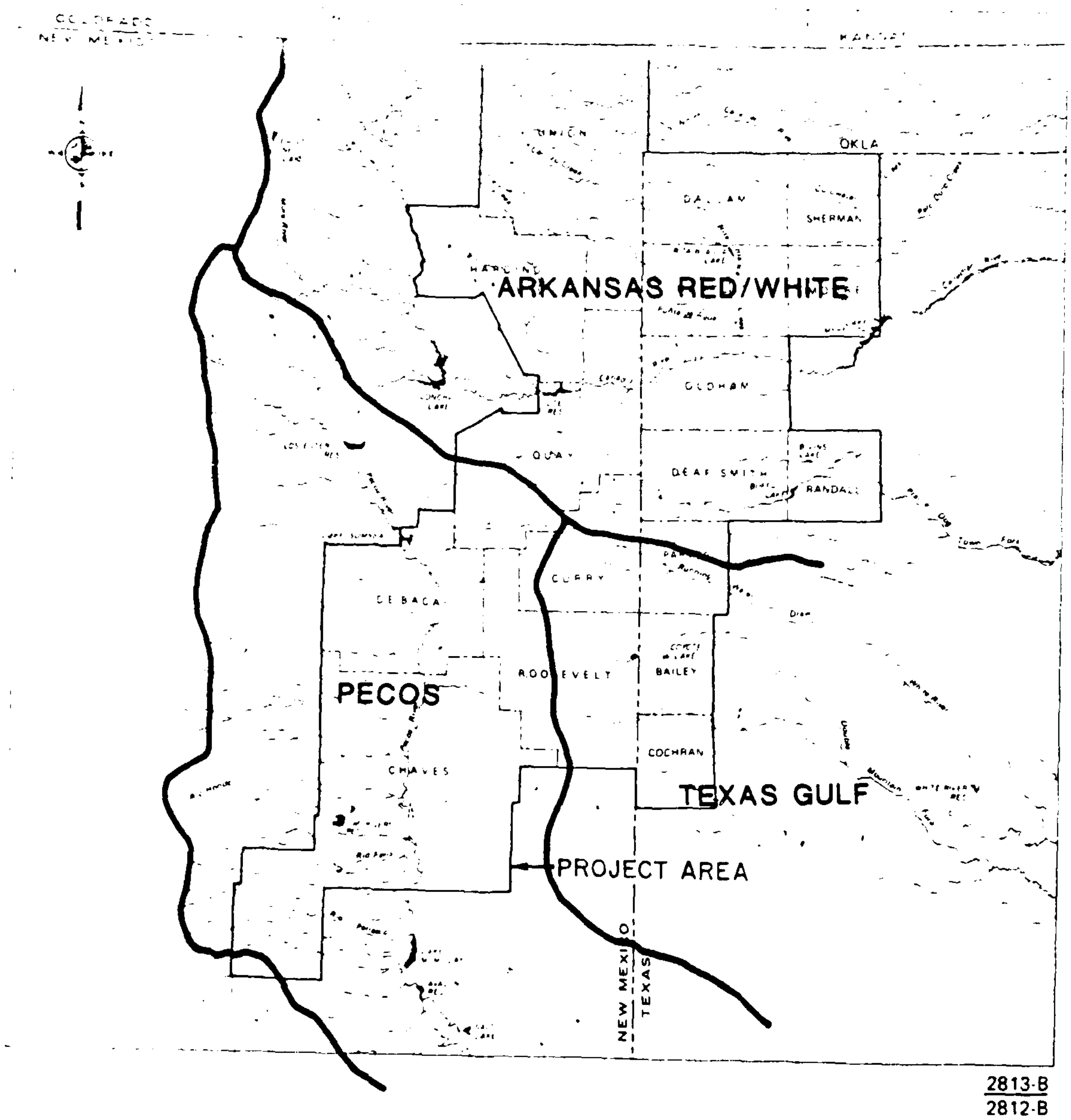

Figure 3.3.2.2-1. Drainage basins in Texas/New Mexico.

Mexico (Figure 3.3.2.2-1). The locations of major and minor water courses, surface water reservoirs, and gauging stations for both stream flow and water quality records for the project area are summarized in Table 3.3.2.2-1. The major surface water projects (reservoirs) that are presently operating and drainage areas that are regulated by interstate compacts are shown on Figure 3.3.2.2-1.

The Canadian River flows through Quay County, New Mexico, and Oldham and Moore counties, Texas. Stream flow is regulated principally by the Ute Reservoir in New Mexico and Lake Meredith in Texas. Lake Meredith supplies water for municipal and industrial uses in 11 west Texas cities, but the contracted amount of this water is only 103,000 AFY. Water from Ute Reservoir is available for municipal and industrial uses but is largely unsold at present. Ute Reservoir has been designed to comply with the provisions of the Canadian River Compact, which allow a maximum conservation storage capacity of 200,000 acre-feet between Conchas Dam and the New Mexico/Texas state line. At present, the conservation storage capacity of Ute Reservoir is about 90,000 acre-feet. The reliable yield of Ute Reservoir is estimated at approximately 10-15,000 acre-feet per year. However, the water is used only for municipal purposes at a state park and for gravel washing.

At present, Texas essentially has free and unrestricted use of waters in the Canadian River Basin in Texas, excluding the North Canadian River. Lake Meredith effectively controls all of the developable surface water resources in Texas in accordance with provisions of the Compact. Water from Lake Meredith is sold to 11 cities for municipal and industrial uses. The contracted amount of water from the reservoir, 103,000 AFY, is assumed to be the reliable yield. However, the quantity of water released to the cities in the last five years has averaged about 70,000 acre-feet per year (U. S. Water and Power Resources Service, 1980).

In recent years, water supplied from Lake Meredith for municipal uses has had to be mixed with ground water to improve the overall quality.

The Pecos River flows through De Baca and Chaves Counties, New Mexico. Stream flow is regulated principally by Los Esteros Reservoir, north of the project area, and by Lake Sumner. Water uses (both ground and surface water) must comply with provisions of the Pecos River Compact, which state that upstream use of the Pecos River shall not diminish the flow entering Texas below the amount available under 1947 conditions. The Pecos River is being adjudicated at present by the U.S. Supreme Court in a suit between New Mexico and Texas.

The average annual discharge of the Pecos River in the project area is approximately 150,000 AFY. Losses of streamflow take place in the reach of the Pecos River between Sumner Dam and Acme. The river gains base flow from seepage of ground water in the reach between Acme and Lake Arthur. Water in the Pecos River in the project area is slightly saline. The water probably is adequate for irrigation but unsuitable for municipal uses. In the reach between Sumner Dam and Acme, the water quality shows a marked degradation.

Virtually all surface water in the project area is appropriated and is being used beneficially within the terms of international treaties, interstate compacts, court decrees and state laws. A major exception is water in Ute Reservoir, which has been appropriated by the New Mexico Interstate Stream Commission but is largely

Table 3.3.2.2-1. Records of gauging stations in the Texas/ New Mexico study area.

STATION NUMBER	STATION NAME	DRAINAGE AREA (SQUARE MILES)	AVERAGE DISCHARGE (ACRE-FEET/YEAR)	YEARS OF RECORD	MEAN SPECIFIC CONDUCTANCE (MICROMHOS/CM)	REMARKS
	ARKANSAS-WHITE RIVER BASIN					
[illegible]	Bennett Spring near Capulin, NM	-	-	[illegible]	-	[illegible]
[illegible]	[illegible] Cimarron River near [illegible], NM	[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	Cimarron River near Folsom, NM	[illegible]	[illegible]	[illegible]	-	Discontinued [illegible]
[illegible]	Ute Creek near Logan, NM	[illegible]	[illegible]	[illegible]-1978	-	-
[illegible] [illegible]	Ute Reservoir near Logan, NM	[illegible]	-	[illegible]-1978	[illegible]	Reservoir [illegible]
[illegible]	Canadian River at Logan, NM	[illegible]	284,[illegible]	1909, 1912-191[illegible], 1927-1938	-	Prior to completion of Conchas Dam
			186,[illegible]	1939-196[illegible]	-	Prior to completion of Ute Dam
			[illegible]	196[illegible]-1978	-	-
[illegible]	Revuelto Creek near Logan, NM	78[illegible]	33,48[illegible]	1960-1978	[illegible],74[illegible]	-
[illegible]	Tamerlo Creek near Stead, NM	[illegible]	No flow most of the time	196[illegible]-197[illegible]	-	Discontinued 197[illegible]
[illegible]	Canadian River above New Mexico-Texas state line in NM	[illegible]	-	-	[illegible]	Water quality data only
[illegible]744-	Punta De Agua Creek near Channing, TX	[illegible],50	No flow most of the time	196[illegible]-197[illegible]	[illegible]	Discontinued [illegible]
[illegible]	Canadian River at Tascosa, TX	[illegible]	19[illegible],63[illegible]	1969-19[illegible]	[illegible]	Discontinued [illegible]
	RED RIVER BASIN					
[illegible]	Tierra Blanca Creek above Buffalo Lake near Umbarger, TX	5[illegible]	[illegible],48[illegible]	194[illegible]-1964, 196[illegible]-19[illegible]	-	Discontinued [illegible]
[illegible]	Buffalo Lake near Umbarger, TX	[illegible]	-	19[illegible]-1964, 196[illegible]-197[illegible]	-	Reservoir contents discontinued
[illegible]	Tierra Blanca Creek below Buffalo Lake near Umbarger, TX	[illegible]	Very little flow most of the time	196[illegible]-197[illegible]	-	Discontinued [illegible]
[illegible]	Prairie Dog Town Fork Red River near Canyon, TX	[illegible]	[illegible]	1925-194[illegible]	-	Discontinued 194[illegible]
[illegible]	Palo Duro Creek at Amarillo City (Bivins Lake), TX	5[illegible]	[illegible]	194[illegible]-1954	-	Discontinued [illegible]
	PECOS RIVER BASIN					
[illegible]	Lake Sumner near Fort Sumner, NM	4,39[illegible]	-	1936-1978	-	Reservoir contents
[illegible]	Pecos River below Sumner Dam, NM	4,39[illegible]	[illegible]	1913-193[illegible]	-	Prior to completion of Sumner Dam
			148,50[illegible]	193[illegible]-1978	[illegible]	-
[illegible]	Fort Sumner Main Canal near Fort Sumner, NM	-	[illegible],50[illegible]	194[illegible]-194[illegible], 1954-1978	-	-
[illegible]	Pecos River near Acme, NM	[illegible]	[illegible]	[illegible]-1978	[illegible]	-
[illegible]	Rio Hondo at Diamond A Ranch near Roswell, NM	94[illegible]	[illegible]	194[illegible]-197[illegible]	-	-
[illegible]	Two Rivers Reservoir near Roswell, NM	[illegible] (Rio Hondo) [illegible] (Rock Arroyo)	No content in 197[illegible] and most of time	196[illegible]-197[illegible]	-	Reservoir contents
[illegible]	Rio Hondo below Diamond A Ranch near Roswell, NM	9[illegible]	[illegible],47	1964-1978	-	-
[illegible]	Rocky Arroyo at Two Rivers Reservoir near Roswell, NM	[illegible]	[illegible]	1964-1978	-	-
[illegible]	Rocky Arroyo below Rocky Dam near Roswell, NM	64	[illegible]	1964-197[illegible]	-	-
[illegible]	North Spring River at Roswell, NM	[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	Pecos River near Hagerman, NM	[illegible]	[illegible] at a low flow station only	-	-	-
[illegible]	Rio Felix at [illegible] Highway Bridge near Hagerman, NM	[illegible]	[illegible]	[illegible]	-	
[illegible]	Pecos River near Lake Arthur, NM	[illegible]	[illegible]	[illegible]	-	-
[illegible]	Rio Peñasco near Dunken, NM	[illegible]	[illegible]	[illegible]		[illegible]

Note: Location of gauging stations shown [illegible]

Source: [illegible]

unused at present. This water would be available under contract to the Interstate Stream Commission. The reliable yield of Ute Reservoir is estimated to be 10-15,000 acre-ft per year.

Other major surface water resources in the project area would be available only by purchase of water rights or lease of water from existing users. Development of these surface water resources for purposes of the proposed project M-X would require retiring existing uses of the water. Water in Lake Meredith in Moore County, Texas, must be purchased from the Canadian River Municipal Water Authority. Rights to water flowing or in storage along the Pecos River in New Mexico would have to be purchased or leased from irrigation districts. When contemplating the acquisition of water from the Pecos River, it is important to purchase or lease water rights that are of relatively senior priority, in order to assure the availability of water in times of short supply. In addition, without prior treatment, the quality of water in parts of the Pecos River may not be satisfactory for the purpose of the proposed M-X project.

Administration of Water Rights (3.3.2.2.1)

New Mexico

Systems of Water Appropriations. All surface water and ground water in New Mexico belongs to the public and is subject to appropriation for beneficial use. Beneficial use is the basis, measure, and limit to the right to use water, and priority in date of appropriation gives the better right. The administration of water rights in New Mexico is under the jurisdiction of the state engineer as set forth in provisions of the constitution and statutes of the state, by adjudications of the courts, and by terms of interstate compacts.

Surface water throughout the state of New Mexico is subject to regulation by the state engineer under the 1907 water code (New Mexico Statutes, 1953, Annotated, Volume II, Part 2). Groundwater in certain areas of the state is also subject to control by the state engineer under the groundwater code enacted in 1931 (New Mexico Statutes, 1953, Annotated, Volume II, part 2). The authority of the state engineer exists only in so-called "declared undergound water basins," basins declared by the state engineer to have reasonably ascertainable boundaries and for which management controls are necessary. The state engineer may declare an undergound water basin without obtaining judicial approval. At the present time, there are 27 declared underground water basins in New Mexico, encompassing approximately 59 percent of the land area of the state.

Four concepts of New Mexico water law are important to consider in the selection of an available source of water for Project M-X. First, water rights are considered to be property rights; as such they may be transferred, sold, or leased. Second, water rights are not necessarily appurtenant to the land on which the water is diverted or extracted. One may own a water right that permits pumping of water from one groundwater basin and applying the water to beneficial use in another basin.

Third, the mining (overdrafting) of groundwater basins is permitted in New Mexico. The state engineer decides whether the groundwater in a particular basin will be mined. In a mined basin, the state engineer determines the rate at which the groundwater reservoir will be depleted. The lowering of water levels in a mined basin caused by the pumping of groundwater by relatively junior appropriators, together with the resulting increase in pumping costs and decrease in well yields, does not necessarily constitute an impairment of the rights of relatively senior appropriators. Finally, New Mexico water law does not establish a priority of uses for water, so that use of water for irrigation is as appropriate a beneficial use as is the use of water for municipal and industrial purposes.

Status of Appropriations. All or part of five declared underground water basins are present in the project area. Four of these, the Canadian River, Fort Sumner, Penasco and Roswell Underground Water Basins, are classified as stream connected, in which ground-water extraction may result in a decrease in the discharge of surface streams in the basin. No new permits to appropriate groundwater in these basins are allowed by the state engineer unless the immediate and potential effects of this appropriation are offset by the retirement of existing surface water rights.

In the Portales underground water basin, mining of groundwater is permitted at rates set by the state engineer. This basin is probably fully appropriated except for about 5,000 acre-ft per year in the sand hills in the eastern part of the basin (Jim Wright, New Mexico State Engineer Office, 1979, personal communication).

Outside of these declared basins in the project area, the drilling and pumping of water wells in unregulated. However, it is reasonable to assume that the state engineer may declare a new basin in an area where relatively large new uses of groundwater are proposed.

Surface water in the project area is fully appropriated except in the Arkansas-Red/White River Basins. About 10-15,000 acre-ft per year from the Dry Cimarron River may be available for appropriation. In the Canadian River Basin, Ute Reservoir has been designed to hold 200,000 acre-ft of conservation storage, the maximum allotted under the Canadian River Compact, when spillway gates are installed. These gates have not been built yet, although bonds for most of the construction costs have been authorized by the New Mexico Legislature. The present conservation storage capacity of Ute Reservoir is 90,000 acre-ft of unappropriated rights. It may be possible to divert streamflow in Revuelto Creek (approximately 35,000 acre-ft per year) until such time as spillway gates on Ute Dam have been installed (Slingerland, New Mexico Interstate Stream Commission, 1980, personal communication).

The Pecos River in New Mexico is generally believed to be overappropriated. The Carlsbad Irrigation District, south of the project area, has the oldest priority (1887 and 1888) for large quantities of direct flow in the river. The District also has the right to store 300,000 acre-ft per year in Los Esteros Reservoir and Lake Sumner, with a priority date of 1906. By stipulation, the Fort Sumner Irrigation District in northern De Baca County has the right to divert the first 100 cfs (35,000 acre-feet per year) in the Pecos River. This water is released from Lake Sumner.

Other uses of water from the Pecos River in the project area either are small or have relatively junior priorities. Included in this latter category are rights to pump groundwater in the Fort Sumner and Roswell underground water basins. The U.S. Supreme Court, in the suit between Texas and New Mexico regarding the Pecos

River Compact, has defined the provision of the Compact regarding 1947 conditions. New Mexico, in maintaining the flow entering Texas that was occurring in 1947, must account for river losses due to development of groundwater in the Roswell Basin as of 1947. The full effect of depletion in the surface flow of the Pecos River due to pumping in 1947 may not yet have occurred. When rights in the Pecos River are adjudicated as a result of this suit, many groundwater rights in the Fort Sumner and Roswell areas may have to be retired (Slingerland, 1980, personal communication).

Texas

Systems of Water Appropriation. Surface water within a defined watercourse in Texas is public water and is subject to appropriation for beneficial use. Beneficial use is the basis, measure and limit of the right to use water, and priority in date of appropriation gives the better right. Besides priority in date of appropriation, the following priorities for types of beneficial uses are also applicable: (1) domestic and municipal; (2) industrial; (3) irrigation; (4) mining and recovery of minerals; (5) hydroelectric power; (6) navigation; (7) recreation and pleasure; and (8) other beneficial uses. Whether priority by date of priority by use takes precedence has not been decided by Texas courts. Surface water rights are adminstered by the Texas Water Commission of the Texas Department of Water Resources. An adjudication of water rights in the Canadian River Basin in the project area is underway, and a report of water-rights claims has been issued (Water Rights Adjudication Section, 1980).

Groundwater in Texas belongs to the individual landowners and is, therefore a private right. Texas courts have followed unequivocally the "English" or "common law" rule that the landowner has a right to take for use or sale all the water he can capture from beneath his land. Owners of land overlying defined groundwater reservoirs (i.e., the Ogallala aquiffer) may voluntarily adopt well regulation through mutual association in underground water conservation districts.

Three underground water conservation districts have been created in the project area. Only two of those districts, North Plains Ground Water Conservation District No. 2 and High Plains Underground Water Conservation District No. 1., are active. These districts are headquartered in Dumas and Lubbock, respectively, and have jurisdiction in part of the project area. The principal rules established by the districts that control use of ground water are the required minimal spacings for wells. The spacing between wells depends on the design discharge of the well, as measured by the inside diameter of the pump column. For example, in the North Plains Ground Water Conservation District No. 2, a proposed well with a 10-inch or larger pump must be spaced at least 500 yds from the nearest well. Other wells of the districts prohibit the waste and pollution of water.

Status of Appropriations. Surface water in the project area is considered by state authorities to be fully appropriated. Existing surface water impoundments control most of the developable surface water supplies. In the Canadian River Basin, the Canadian River Municipal Water Authority has rights to use approximately 150,000 acre-ft per year from Lake Meridith for municipal and industrial purposes. Their permit is subject to the provisions of the Canadian River Compact, which will not be enforced until Oklahoma builds more reservoirs for conservation storage. In the Red River Basin there are water-rights permits for both Bivins and

Buffalo Lakes, although springflow that once supplied Buffalo Lake has dried up (Settemeyer, Permits Division, Texas Department of Water Resources, personal communication, 1980). In the Brazos and Colorado River Basins surface runoff is not sufficient to administer under a system of water rights (Haisler, Permits Division, Texas Department of Water Resources, personal communication, 1980).

East of the project area in Hansford County, Texas, the Palo Duro River Authority of Texas has rights to approximately 10,000 acre-ft of water per year in Palo Curo Creek for municipal use. A reservoir to store this water has been permitted but has not been constructed (Water Rights Adjudication Section, 1980).

Air Quality (3.3.2.3)

Meteorology

The climate is semi-arid with dry winters and is transitional between the desert to the west and the humid coastal regions to the east. Precipitation varies widely in location and amount throughout the year. Flash flooding is common locally. Tornadoes may occur from May through August. Dust storms occur frequently in the spring and are associated with frontal passages. This area has the highest incidence of naturally caused windblown dust in the United States (Table 3.3.2.3-1). The study area has good vertical mixing and small potential for high concentrations of gaseous pollutants.

Air Quality

The federal, Texas, and New Mexico ambient air quality standards are presented in Tables 3.3.2.3-2 and 3.3.2.3-3. In addition to the federal standards, Texas has adopted more strict short-term particulate standards.

The New Mexico particulate standard is identical to the secondary federal standard. As for gaseous pollutants, the Texas and federal standards are identical; the New Mexico standards are stricter than the corresponding federal standards. The federal primary annual and 24-hour particulate standards have been exceeded at several locations in the study area; e.g., Lubbock, Texas, and Hobbs and Clovis, New Mexico. Sulfur dioxide, ozone, and carbon monoxide levels remain below standards.

Mandatory Class I areas (no degradation permitted) located in the air quality study area of New Mexico and Texas are Carlsbad Caverns, White Mountain Wilderness Area, Wheeler Peak Wilderness Area, and Pecos Wilderness Area. The air quality study area boundary and Class I areas are shown in Figure 3.3.2.3-1.

One Class II area (some degradation permitted) in the study area is recommended for consideration for redesignation to Class I status, the Capulin Mountain National Monument in New Mexico.

Mining and Geology (3.3.2.4)

Sesmicity (3.3.2.4.1)

No active earthquake region is in the study area. Only minor damage can be expected to occur from distant earthquakes.

Table 3.3.2.3-1 Monthly percent frequency of dust observations in the Texas/New Mexico regions.

MONTH	PERCENT FREQUENCY[1]			
	CLOVIS	CLAYTON	AMARILLO	LUBBOCK
January	1.400	2.400	0.700	2.900
February	3.100	0.620	2.100	4.500
March	6.000	3.348	3.400	7.700
April	5.500	1.541	3.200	7.600
May	2.700	0.427	1.100	4.500
June	1.500	0.284	0.700	2.800
July	0.500	0.061	0.300	0.500
August	0.300	0.061	0.100	0.200
September	0.700	0.346	0.400	0.500
October	0.600	0.065	0.400	0.500
November	1.000	0.068	0.600	1.400
December	2.000	0.304	1.300	3.400
Annual Average	2.100	0.610	1.200	3.100

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[1] The percentage of hourly weather observations in which dust is reported as a restriction to visibility.

Source: Orgill and Sehmel (1975).

Table 3.3.2.3-2. Summary of National Ambient Air Quality Standards (NAAQS) and Texas/New Mexico Ambient Air Quality Standards.

POLLUTANT	AVERAGING TIME	NAAQS		TEXAS STANDARDS	NEW MEXICO STANDARDS
		PRIMARY	SECONDARY		
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 μg/m³	60 μg/m³ [a]	Same as NAAQS	60 μg/m³
Total Suspended Particulate Matter	24-hour [b]	260 μg/m³	150 μg/m³	150 μg/m³	150 μg/m³
Total Suspended Particulate Matter	1-hour [c]	--	--	400 μg/m³	N/A
Total Suspended Particulate Matter	3-hour [c]	--	--	200 μg/m³	N/A
Total Suspended Particulate Matter	5-hour [c]	--	--	100 μg/m³	N/A
Lead	Quarterly (Arithmetic Mean)	1.5 μg/m³	--	Same as NAAQS	Same as NAAQS

[a] Secondary annual NAAQS TSP standard (60 μg/m³) is a guide for assessing state implementation plans.

[b] Not to be exceeded more than once per year.

[c] Not to be exceeded any time by any single major stationary source or group of sources located on contiguous property.

Table 3.3.2.3-3. Summary of National Ambient Air Quality Standards (NAAQS) and Texas and New Mexico ambient air quality standards for gaseous pollutants.

POLLUTANT	AVERAGING TIME	NAAQS PRIMARY	NAAQS SECONDARY	TEXAS STANDARDS	NEW MEXICO STANDARDS
Carbon Monoxide	8-hour[a]	10 mg/m³ 9 ppm	Same as primary standard	Same as NAAQS	[illegible] mg/m³ [illegible] ppm
	1-hour[a]	40 mg/m³ 35 ppm			[illegible] mg/m³ [illegible] ppm
Carbon Monoxide above 5,000 ft MSL	8-hour[a]	[illegible] mg/m³ 9 ppm			
	1-hour[a]	40 mg/m³ 35 ppm			
Ozone	1-hour[b]	235 µg/m³ 0.12 ppm	Same as primary standard	Same as NAAQS	[illegible] µg/m³ [illegible] ppm
Nitrogen Dioxide	Annual Arithmetic Mean	100 µg/m³ 0.05 ppm	Same as primary standard	Same as NAAQS	
Hydrocarbons Corrected for Methane	3-hour (6-9 a.m.)	160 µg/m³ 0.24 ppm	Same as primary standard	Same as NAAQS	
Sulfur Dioxide	Annual Arithmetic Mean	80 µg/m³ 0.03 ppm	Same as primary standard	Same as NAAQS	52 µg/m³ [illegible] ppm
	24-hour[a]	365 µg/m³ 0.14 ppm			[illegible] µg/m³ [illegible] ppm
	3-hour[a]	none	1,300 µg/m³ 0.5 ppm		Same as NAAQS

(57)

[a]Not to be exceeded more than once per year.

[b]The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

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DRAFT ENVIRONMENTAL IMPACT STATEMENT. MX DEPLOYMENT AREA SELECT--ETC(U)

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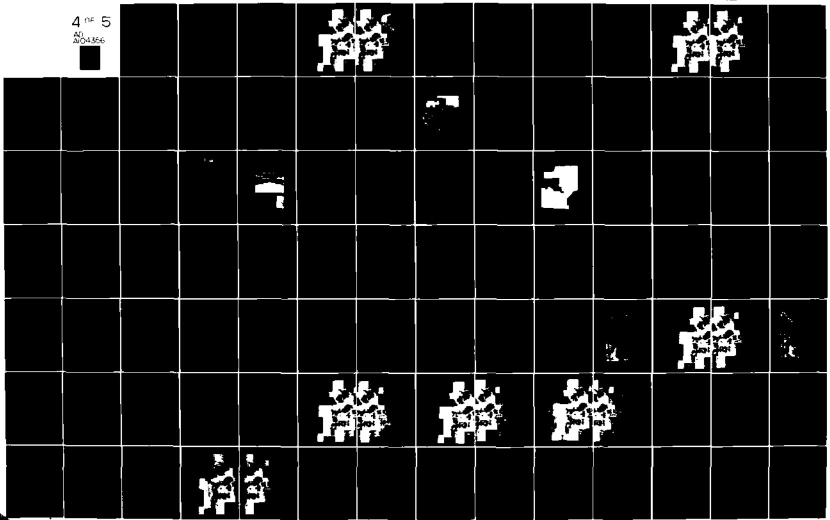


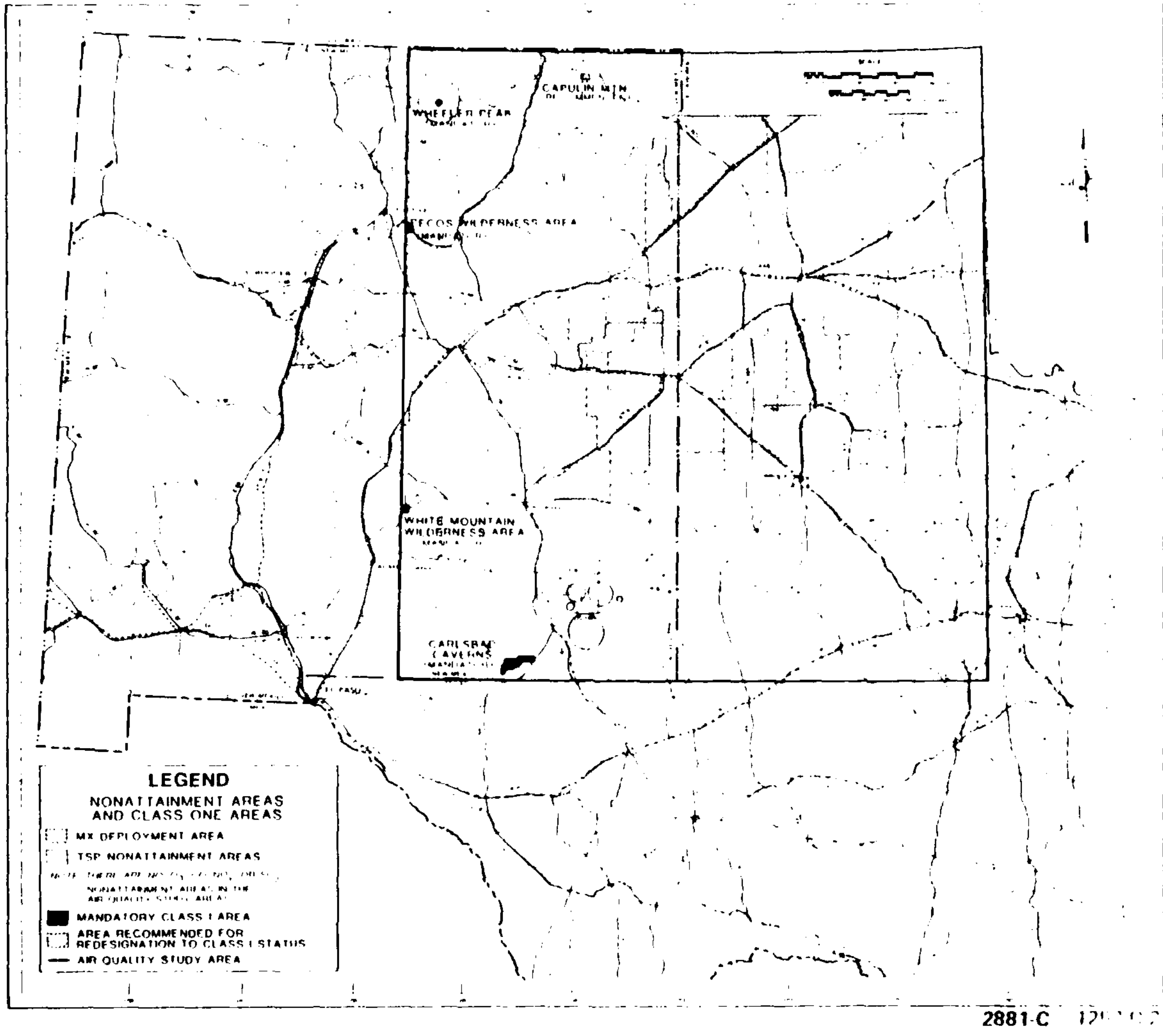


Figure 3.3.2.3-1. Class I and nonattainment areas near the Texas/New Mexico geotechnically suitable area.

Minerals (3.3.2.4.2)

The major minerals are oil, natural gas, sand and gravel, natural carbon dioxide, lime, and scoria. Potential deposits of copper, gold, uranium, potash, salt, high calcium limestone, vanadium, and diatomaceous earth have been identified.

Sherman and Cochran counties in Texas, and Roosevelt County in New Mexico, contain giant oil or natural gas fields and have been continuously explored for many years. Several counties in eastern New Mexico remain largely unexplored for oil and gas, mostly because they do not contain favorable source and reservoir rocks. Figure 3.3.2.4-1 indicates areas of oil and gas and uranium potential.

Tables 3.3.2.4-1 and 3.3.2.4-2 present the value of mineral production in the study area by county.

Playas (3.3.2.4.3)

Texas/New Mexico playas are intermittent to permanent ponds forming in wind-deflation basins filled by surface runoff after rains, and are not associated with any major drainage systems. The lakes vary in size and depth, ranging from several feet to several miles in diameter, and from inches to feet in depth. The larger playas have been excluded from the suitable areas.

Vegetation and Soils (3.3.2.5)

Much of the study area has been previously cleared for agricultural purposes. Most Texas counties have over 50 percent cropland, while much smaller percentages occur in New Mexico (except for Curry County).

The undisturbed natural vegetation of the study area is limited in extent, and is composed mainly of fast-growing prairie grasses, including blue grama grassland and mixed grama grassland vegetation types, which have moderately fast recovery potential (Figure 3.3.2.5-1). Uplands, canyons, and riparian areas are dominated by woodlands with large shrubs and small tress. Characteristics of natural vegetation types are summarized in Table 3.3.2.5-1.

The study area has two major soil types, Alfisols and Mollisols. Found on gently undulating upland surfaces, both are alkaline, generally fertile, and suitable for irrigated crops. Aridisols occur in only small regions. Figure 3.3.2.5-2 shows soil groups in the study area. In general, erosion potential from wind is high.

Wildlife (3.3.2.6)

Common and Typical Species (3.3.2.6.1)

Wildlife is a subset of Great Plains fauna. Animal species diversity is limited due to low habitat diversity. Diversity increases in the northwest and west central (near Santa Rosa, New Mexico) portions, due to increasing topographic relief as well as decreasing aridity. The southwestern portion is arid grassland. Amphibians are most common in riparian habitats and include toads and salamanders. Reptiles are found in all habitat types. The vast majority of bird species are found in the riparian habitats. However, others congregate in the canyon/upland habitats. The mammals include opossums, shrews, bats, armadillos, rabbits, rodents, carnivores (such as coyotes and foxes), and hoofed animals (such as mule deer, white-tailed deer, and pronghorn). Tables 3.3.2.6-1, 3.3.2.6-2, and 3.3.2.6-3 show all terrestrial animals that may occur in or near the study area, whether rare or abundant.

Game Animals (3.3.2.6.2)

Big game species are mule deer (Figure 3.3.2.6-1), white-tailed deer (Figure 3.3.2.6-1), pronghorn (Figure 3.3.2.6-2), and, at the edge of the area, barbary sheep (aoudad) (Figure 3.3.2.6-3). Important upland game (Figure 3.3.2.6-4) include mourning dove, bobwhite, scaled quail, pheasant, lesser prairie chicken, turkey, and cottontail rabbits. Much of the Texas study area is cropland, which supports such upland game as pheasant and bobwhite. Most game birds live in canyon/upland habitats. Beaver, muskrat, raccoon, badger, skunk, coyote, fox, and bobcat comprise the majority of furbearers trapped or hunted. Playa lakes are important habitat to migratory ducks, geese, and other waterfowl along the Central Flyway. Several national wildlife refuges are located in the region, providing a high-quality habitat for migratory and breeding waterfowl.

Aquatic Species (3.3.2.7)

Aquatic Habitat (3.3.2.7.1)

Playa lakes are the major aquatic habitat, but biotic diversity is limited by harsh conditions (e.g., periodic drying, high salinity, wide fluctuations in water level, and agricultural and oil field pollution) (Figure 3.3.2.7-1).

Aquatic Biota (3.3.2.7.2)

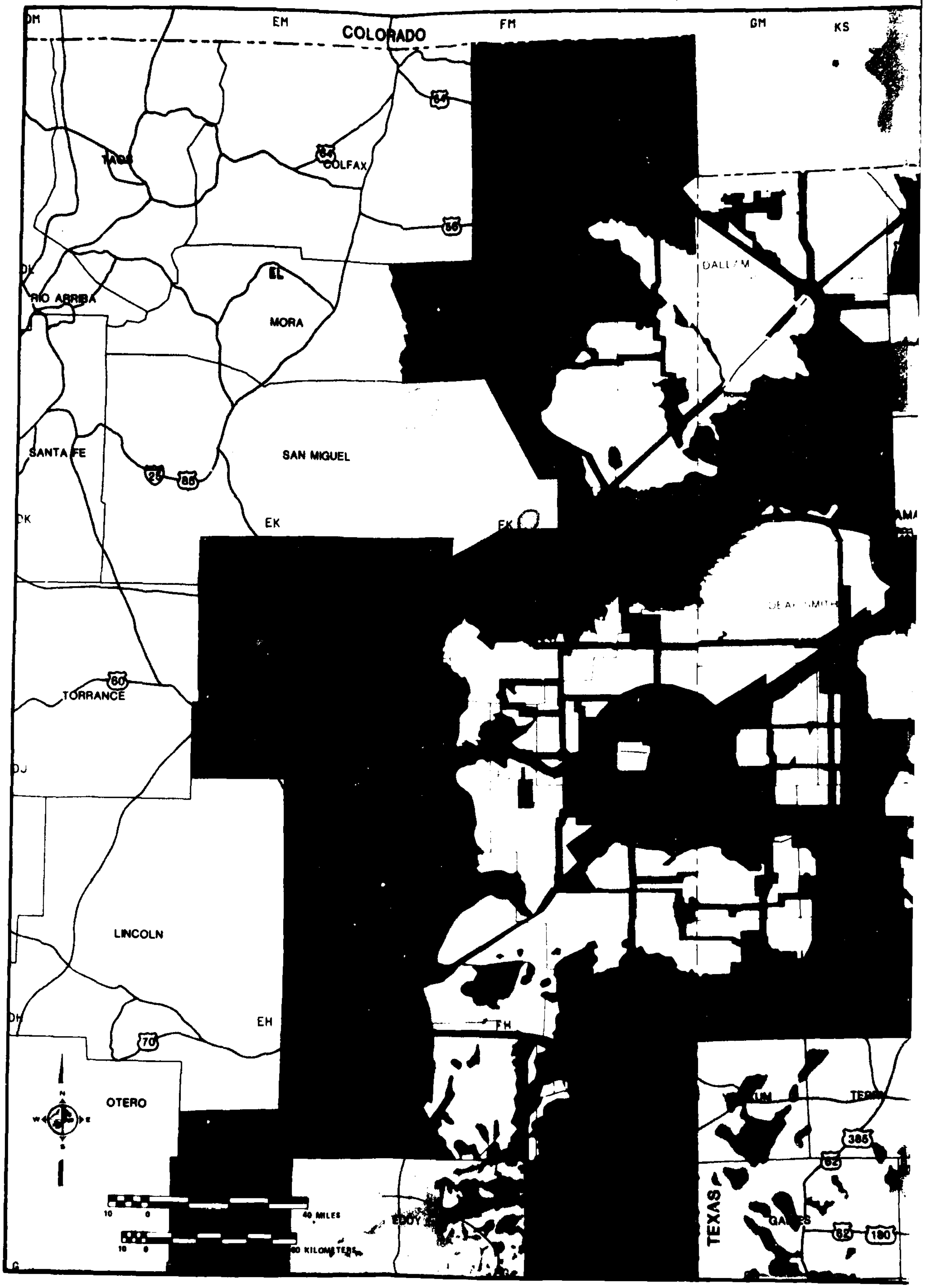
Twenty-eight fish species in the area have some commercial or sport value (Table 3.3.2.7-1). Several minnow species, game fish species, and rough fish are found in the river systems, reservoirs, and ponds. In many areas, highly mineralized or intermittent waters allow only native and other undesireable introduced fishes such as carp, carpsuckers, and redhorse to survive. The most significant sport fishes are largemouth bass, catfish, and sunfish. Few endemic species occur because of the temporary nature of most aquatic habitats.

Protected Species (3.3.2.8)

The term "protected species" applies to rare, threatened, or endangered species that are condidates for or already included on state or federal lists. For ferderally listed, proposed, and candidate species, Section 7 consultation under the Endangered Species Act of 1973 was intiated with the U.S. Fish and Wildlife Service by the Air Force on September 3, 1980.

Plant Species (3.3.2.8.1)

No federally protected plant species occur in the study area. Kuenzler's barrel cactus (Echinocereus kuenzleri) is the closest federally listed endangered species, and it is known to occur in the Sacramento Mountains, southwest of the study area. State-proposed protected species do exist and are shown in Table 3.3.2.8-1. Their spatial distribution is shown in Figure 3.3.2.8-1.


COLORADO
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OTERO
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385
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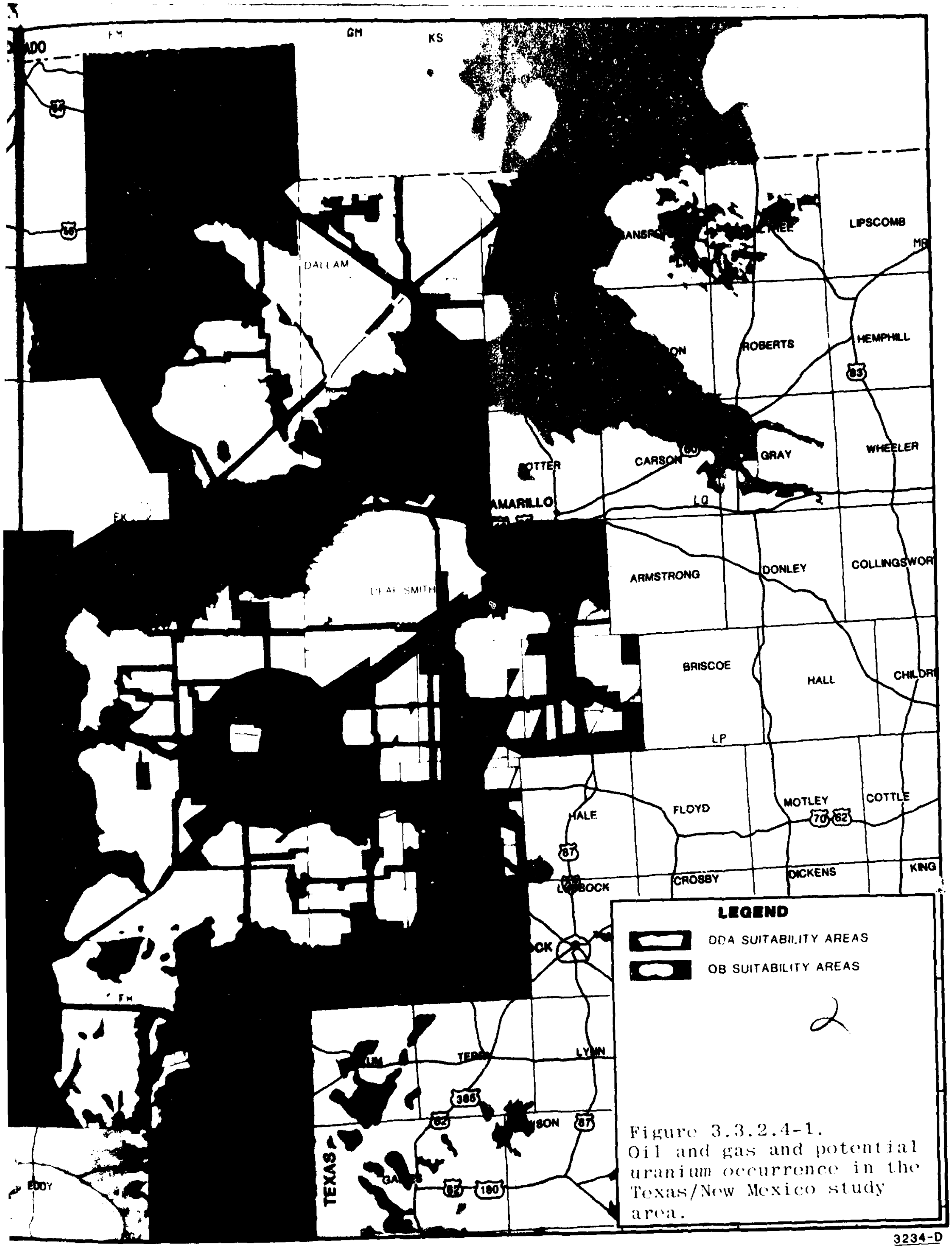

Figure 3.3.2.4-1.
Oil and gas and potential uranium occurrence in the Texas/New Mexico study area.

Table 3.3.2.4-1. Texas mineral production in 1976 by county within the study area.

COUNTY	VALUE	MINERALS	PERCENT OF STATE TOTAL ($18.1 BILLION)
Bailey	W	Stone	
Cochran	$169,270,000	Petroleum, Natural Gas	0.9
Dallam	W	Natural Gas	
Oldham	$ 4,496,000	Petroleum, Natural Gas Sand & Gravel	0.02
Parmer	W	Stone	
Sherman	$ 42,439,000	Petroleum, Natural Gas	0.2
Hartley	W	Natural Gas	
Deaf Smith	W	Limestone (Caliche)	

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W - Figures withheld to prevent disclosure of single company production; state totals do not include county withheld values.

Source: Minerals Yearbook, 1976.

Table 3.3.2.4-2. Value of mineral production in New Mexico by county within study area 1976.

COUNTY	VALUE	MINERALS	PERCENT OF STATE TOTAL ($2.5 BILLION)
Chaves	$20,387,000	Petroleum, Natural Gas, Sand and Gravel, Stone	0.8
Curry	W	Sand and Gravel	
DeBaca	W	Sand and Gravel	
Harding	$ 80,000	Carbon Dioxide	0.003
Quay	W	Sand and Gravel, Stone	
Roosevelt	$19,048,000	Petroleum, Natural Gas, Stone	0.75
Union	W	Pumice, Sand and Gravel, Stone	

3222

W - Withheld to avoid disclosing proprietary data; state totals do not include county withheld values.

Source: Minerals Yearbook, 1976.

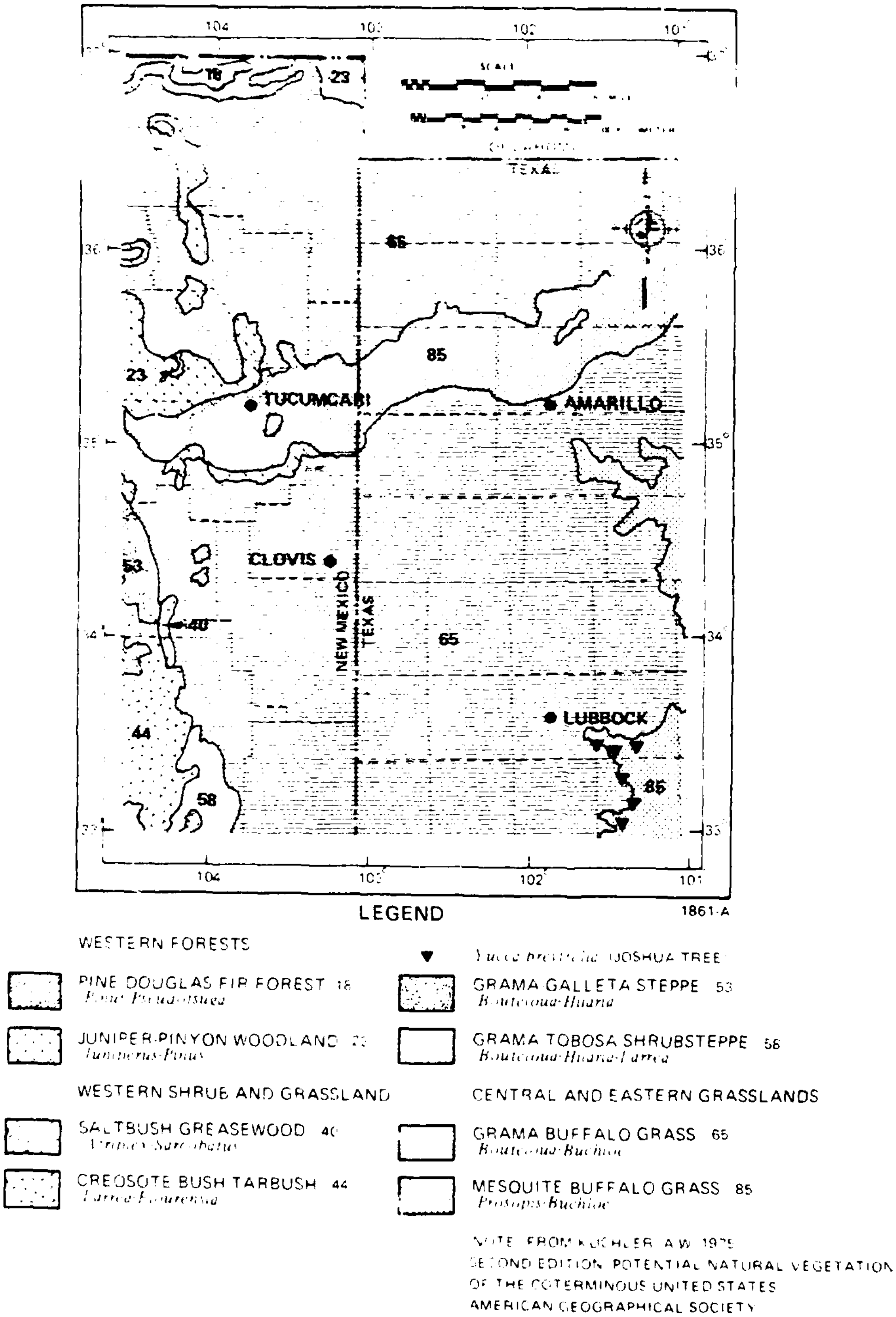

Figure 3.3.2.5-1. Simplified vegetation of the Texas/New Mexico study area.

Table 3.3.2.5-1. Major vegetation types in the Texas/ New Mexico study area.

TYPE	GENERAL LOCATION	COMPOSITION	SOURCE OF PRESENT DISTURBANCE
Blue grama grassland	Clay-clay loam soils, north-northeast portions	Blue grama, buffalo grass	Agriculture, grazing
Mixed grama grassland	Silt loam-sandy loam, most of high plains	Blue grama, side-oats grama, purple three-awn	Agriculture, grazing
Bluestem grassland	Sandy soils	Little bluestem, side-oats grama, sand bluestem, sand sage, shinnery oak	Grazing, agriculture, oil fields
Mesquite grassland	Overgrazed grassland	Honey mesquite, blue grama, little bluestem	Overgrazing, ORVs
Sand dune vegetation	Sand	Shinnery oak, sand sage	Grazing, hunting, ORVs
Desert grassland	Western edge, dry high plains	Black grama, tobosa grass, fluff grass, soap-tree yucca	Grazing, hunting, ORVs
Chihuahuan Desert scrub	Southern edge, high plains	Creosote bush, black grama, bush muhly	Grazing, hunting, ORVs
Upland and canyon break vegetation	Gravelly loam, rolling to steep slopes	Juniper, mesquite, oak	Grazing, hunting, ORVs
Riparian woodland	Stream valleys	Cottonwood, hackberry, willows, mesquite, tamarisk	Hunting, grazing, camping, ORVs
Floodplain vegetation	Salty floodplains	Alkali sacaton, giant dropseed	Grazing, ORVs
Playa lake wetland	Playa lakes on high plains, clay soils	Buffalo grass, wheatgrass, cattail, bulrush, willow	Agriculture, grazing

COLORADO
KS
COLFAX
RIO ARRIBA
MORA
SAN MIGUEL
SANTA FE
TORRANCE
LINCOLN
OTERO
EDDY
DALLAM
DEAF SMITH

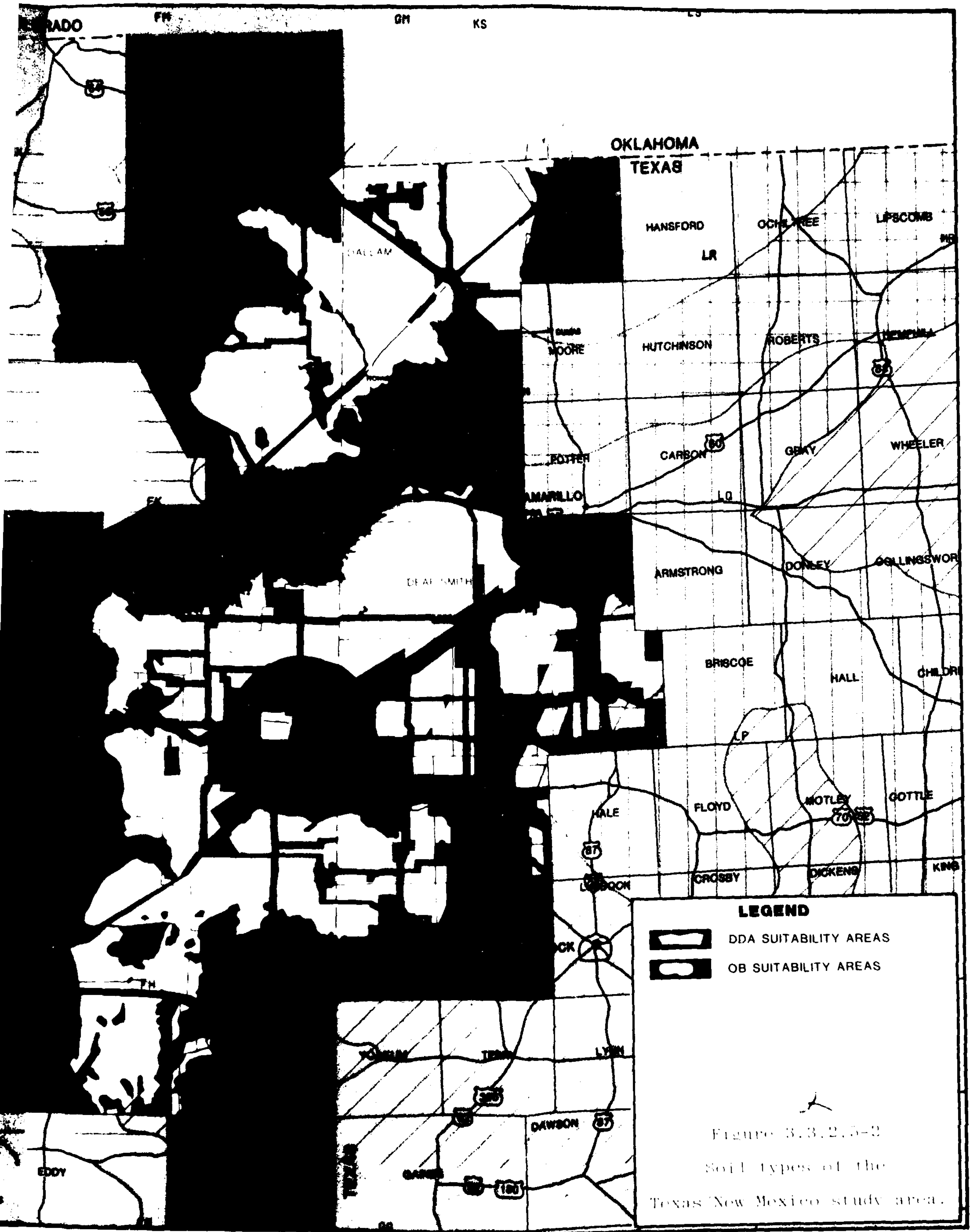

Figure 3.3.2.5-2
Soil types of the
Texas/New Mexico study area.

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Table 3.3.2.6-1. Amphibians and reptiles of the High Plains of Texas and New Mexico by habitat type. State or federally listed endangered species are not included.

COMMON NAME	SPECIES NAME	HABITAT TYPE						
		RIPARIAN	CANYON UPLAND	DESERT SCRUB	DUNE SCRUB[a]	MESQUITE GRASSLAND	SHORTGRASS	AGRICULTURE
Salamanders, Frogs and Toads								
Tiger Salamander	*Ambystoma tigrinum*	X						
Plains Spadefoot	*Scaphiopus bombifrons*	X	X	X		X	X	
Western Spadefoot	*S. hammondi*	X	X				X	
Woodhouses Toad	*Bufo woodhousei*	X						
Great Plains Toad	*B. cognatus*	X	X	X		X	X	X
Green Toad	*B. debilis*	X				X		
Red-spotted Toad	*B. punctatus*	X	X	X				
Bullfrog	*Rana catesbeiana*	X						
Plains Leopard Frog	*R. blairi*	X					X	X
Turtles								
Common Snapping Turtle	*Chelydra serpentina*	X						
Yellow Mud Turtle	*Kinosternon flavescens*	X					X	
Pond Slider	*T. scripta*	X						
Ornate Box Turtle	*Terrapene ornata*			X		X	X	
Lizards								
Collared Lizard	*Crotaphytus collaris*		X				X	
Round-tailed Horned Lizard	*Phrynosoma modestum*		X	X	X			
Lesser Earless Lizard	*Holbrookia maculata*		X	X	X	X		
Side-blotched Lizard	*Uta stansburiana*		X	X	X	X		
Eastern Fence Lizard	*S. undulatus*		X	X	X	X	X	
Great Plains Skink	*E. obsoletus*	X		X		X		
Texas Spotted Whiptail	*C. gularis*		X	X		X		
Checkered Whiptail	*C. tesselatus*		X	X				
Chihuahua Whiptail	*C. exsanguis*		X	X				
Snakes								
Checkered Garter Snake	*T. marcianus*	X				X		
Texas Blind Snake	*L. dulcis*			X	X	X	X	
Western Hognose Snake	*Heterodon nasicus*				X	X		
Prairie Ring-necked Snake	*Diadophis punctatus*	X						
Yellow-bellied Racer	*Coluber constrictor*		X			X	X	
Coachwhip	*Masticophis flagellum*	X	X	X		X		
Glossy Snake	*Arizona elegans*			X		X	X	
Bullsnake	*Pituophis melanoleucus*	X	X	X	X	X	X	
Great Plains Rat Snake	*Elaphe guttata*	X						
Central Plains Milk Snake	*Lampropeltis triangulum*			X		X	X	
Kingsnake	*L. getulus*	X	X	X	X	X		
Great Plains Ground Snake	*Sonora episcopa*			X		X		
Long-nosed Snake	*Rhinocheilus lecontei*		X	X	X	X		
Plains Black-headed Snake	*Tantilla nigriceps*	X	X	X		X	X	
Texas Night Snake	*Hypsiglena torquata*		X	X		X		
Desert Massasauga	*Sistrurus catenatus*		X	X	X	X	X	
Prairie Rattlesnake	*Crotalus viridis*	X	X	X	X	X	X	
Western Diamondback Rattlesnake	*C. atrox*	X	X	X	X	X	X	

[a] Includes shinnery-oak and sand sage dune

Table 3.3.2.6-2. Birds of the High Plains of Texas and New Mexico by states and habitat type (Pg. 1 of 3).

COMMON NAME	SPECIES TYPE	STATUS	HABITAT TYPE: RIPARIAN	[illegible]	[illegible]	[illegible]	MESQUITE GRASS	SHORTGRASS	AGRICULTURE
Loons and Grebes									
Eared Grebe	*Podiceps nigricollis*	MWB	X						
Pie-billed Grebe	*Podilymbus podiceps*	MYL	X						
Herons, Egrets and Ibis									
Great Blue Heron	*Ardea herodias*	YL	X						
Snowy Egret	*Leucophoyx thula*	MB	X						
Black-crowned Night Heron	*Nycticorax nycticorax*	YL	X						
Swans, Ducks and Geese									
Canada Goose	*Branta canadensis*	MFW	X						
Snow Goose	*Chen hyperborea*	MFW	X						
Mallard	*Anas platyrhynchos*	MSSuFW	X						
Gadwall	*A. strepera*	MWB	X						
American Widgeon	*A. americana*	MYLB	X						
Pintail	*A. acuta*	MYLB	X						
Green-winged Teal	*A. crecca carolinense*	MSYL	X						
Blue-winged Teal	*A. discors*	MYLB	X						
Cinnamon Teal	*A. cyanoptera*	MSSuWB	X						
Shoveler	*A. clypeata*	MSSuW	X						
Redhead	*Aythya americana*	MSFW	X						
Canvasback*	*A. valisineria*	MSFW	X						
Lesser Scaup	*A. affinis*	MSFW	X						
Bufflehead	*Bucephala albeola*	MWS	X						
Ruddy Duck	*Oxyura jamaicensis*	MSFW	X						
Hawks, Eagles, and Vultures									
Turkey Vulture	*Cathartes aura*	MSSuB	X					X	
Sharp-shinned Hawk*	*Accipiter striatus*	MSuW	X						
Cooper's Hawk	*A. cooperi*	MYL	X	X	X		X		
Red-tailed Hawk	*Buteo jamaicensis*	MYLB	X	X			X	X	
Rough-legged Hawk	*B. lagopus*	MFW				X		X	
Ferruginous Hawk	*B. regalis*	MYLB	X	X	X	X	X	X	
Swainson's Hawk*	*B. swainsoni*	MYLB	X	X	X	X	X	X	
Golden Eagle	*Aquila chrysaetos*	MYLB	X					X	
Marsh Hawk*	*Circus cyaneus*	MSuFWB	X		X	X	X	X	
Prairie Falcon*	*Falco mexicanus*	MSWB	X					X	
American Kestrel	*F. sparverius*	MYLB	X	X	X	X	X	X	
Gallinaceous Birds									
Bobwhite	*Colinus virginianus*	YLB	X	X					X
Scaled Quail	*Callipepla squamata*	YLB	X	X	X	X	X	X	
Ring-necked Pheasant*	*Phasianus colchicus*	YLB	X	X					X
Rio Grande Turkey	*Meleagris gallopavo*	YLB		X					
Cranes, Rails and Gallinules									
Sandhill Crane	*Grus canadensis*	MSuFW	X						
American Coot	*Fulica americana*	MYLB	X						
Shorebirds									
Snowy Plover	*Charadrius alexandrinus*	MSuF	X						
Killdeer	*C. vociferus*	MYLB	X						X
Common Snipe	*Capella gallinago*	MSFW	X						
Long-billed Curlew	*Numenius americanus*	MSuFWB	X						
Greater Yellowlegs	*Tringa melanoleuca*	MSuW	X						
Baird's Sandpiper	*Calidris bairdii*	MSSuF	X						
Least Sandpiper	*C. minutilla*	MSW	X						
Western Sandpiper	*C. mauri*	MSSuF	X						
American Avocet	*Recurvirostra americana*	MSSuFB	X						
Black-necked Stilt	*Himantopus mexicanus*	MSSuFB	X						
Wilson's Phalarope	*Steganopus tricolor*	MSSuFB	X						
Gulls and Terns									
Ring-billed Gull	*Larus delawarensis*	MSuWB	X						
Black Tern	*Chlidonias niger*	MSSuF	X						
Pigeons and Doves									
Rock Dove (Pigeon)	*Columba livia*	YLB	X						X
Mourning Dove	*Zenaida macroura*	YLB	X	X	X		X	X	X

Table 3.3.2.6-2. Birds of the High Plains of Texas and New Mexico by states and habitat type (Pg. 2 of 3).

COMMON NAME	SPECIES NAME	STATUS	HABITAT TYPE						
			RIPARIAN	[illegible]	DESERT SHRUB	SAND SHRUB	MESQUITE GRASS	SHORTGRASS	AGRICULTURE
Cuckoos									
Yellow-billed Cuckoo	*Coccyzus americanus*	MS[illegible]FB	X						
Roadrunner	*Geococcyx californianus*	[illegible]LB	X	X	X	X		X	
Owls									
Barn Owl	*Tyto alba*	[illegible]	X	X	X		X		X
Great Horned Owl	*Bubo virginianus*	YLB	X	X	X		X		
Burrowing Owl	*Athene cunicularia*	YLB	X			X		X	
Goatsuckers and Swifts									
Common Nighthawk	*Chordeiles minor*	MSSuB	X					X	X
White-throated Swift	*Aeronautes saxatalis*	MSFWB	X						
Woodpeckers									
Common Flicker	*Colaptes auratus*	YL	X	X	X		X		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	MFW							
Ladder-backed Woodpecker	*Picoides scalaris*	YLB	X	X	X		X		
Flycatchers									
Western Kingbird	*Tyrannus verticalis*	MSSuFB	X		X		X		
Say's Phoebe	*Sayornis sayus*	MYL	X	X	X		X		
Western Flycatcher	*Empidonax difficilis*	MSF	X						
Western Wood Peewee	*Contopus sordidulus*	MSSuFB	X						
Larks									
Horned Lark	*Eremophila alpestris*	YLB			X		X	X	
Swallows									
Rough-winged Swallow	*Stelgidopteryx ruficollis*	MSuB	X						
Barn Swallow	*Hirundo rustica*	MSSuFB	X						X
Crows and Jays									
Blue Jay	*Cyanocitta cristata*	[illegible]uFW		X					
Steller's Jay	*C. stelleri*	MSW	X						
Scrub Jay	*Aphelocoma coerulescens*	MSW	X						
White-necked Raven	*Corvus cryptoleucus*	YLB	X		X	X	X	X	
Common Crow	*C. brachyrhynchos*	MSW		X		X	X		X
Pinyon Jay	*Gymnorhinus cyanocephalus*	MSFW	X	X					
Wrens									
House Wren	*Troglodytes aedon*	MSFB	X						
Bewick's Wren	*Thryomanes bewickii*	MSSuWB	X	X	X		X		
Long-billed Marsh Wren	*Cistothorus palustris*	MFW							
Rock Wren	*Salpinctes obsoletus*	MSuWB	X	X					
Mockingbird, Catbirds and Thrashers									
Mockingbird	*Mimus polyglottos*	MYLB	X						
Sage Thrasher	*Oreoscoptes montanus*	MSFW	X		X		X		
Thrushes and Bluebirds									
Robin	*Turdus migratorius*	MYL	X						X
Swainson's Thrush	*Catharus ustulata*	MFW	X						
Eastern Bluebird	*Sialia sialis*	MYL	X						
Mountain Bluebird	*S. currucoides*	MSFW	X	X	X		X		
Gnatcatchers and Kinglets									
Blue-gray Gnatcatchers	*Polioptila caerulea*	MSuFWB		X			X		
Ruby-crowned Kinglet	*Regulus calendula*	MSFW	X						

Table 3.3.2.6-2. Birds of the High Plains of Texas and New Mexico by states and habitat type (Pg. 3 of 3).

COMMON NAME	SPECIES NAME	STATUS	HABITAT TYPE						
			RIPARIAN	CANYON UPLAND	DESERT SCRUBS	DUNE-SCRUB[1]	MESQUITE GRASS	SHORTGRASS	AGRICULTURE
Pipits									
Water Pipit	*Anthus spinoletta*	MSFW	x						
Sprague's Pipit	*A. spraguei*	MSFW							x
Waxwings									
Cedar Waxwing	*Bombycilla cedrorum*	MSFW	x		x		x		
Shrikes									
Loggerhead Shrike	*Lanius ludovicianus*	YLB	x	x	x	x	x		
Starling									
Starling	*Sturnus vulgaris*	MYL	x						
Vireos									
Warbling Vireo	*Vireo gilvus*	MSuF	x						
Warblers									
Black and White Warbler	*Mniotilta varia*	MSSuF	x	x					
Nashville Warbler	*Vermivora ruficapilla*	MSF	x						
Yellow Warbler	*Dendroica petechia*	MSSuB	x	x					
Yellow-rumped Warbler	*D. coronata*	MSFW	x	x					
MacGillivray's Warbler	*Oporornis tolmiei*	MSF	x						
Yellowthroat	*Geothlypis trichas*	MSSuFB	x						
Wilson's Warbler	*Wilsonia pusilla*	MSF	x						
Weaver Finches									
House Sparrow	*Passer domesticus*	YLB	x						
Meadowlark									
Eastern Meadowlark	*Sturnella magna*	YLB	x				x	x	
Western Meadowlark	*S. neglecta*	YLB	x		x	x	x	x	
Blackbirds and Orioles									
Red-winged Blackbird	*Agelaius phoeniceus*	YLB	x						x
Northern Oriole	*Icterus galbula*	MSuB	x						
Brewer's Blackbird	*Euphagus cyanocephalus*	MYL	x						x
Great-tailed Grackle	*Quiscalus mexicanus*	YL	x						
Common Grackle	*Q. quiscula*	MSuW	x	x					
Brown-headed Cowbird	*Molothrus ater*	MYLB	x						x
Grosbeaks, Finches, Sparrows and Buntings									
Blue Grosbeak	*Guiraca caerulea*	MSSuFB	x	x					
Lazuli Bunting	*Passerina amoena*	MSSuF	x						
Dickcissel	*Spiza americana*	MSSuFB	x					x	
Evening Grosbeak	*Hesperiphona vespertina*	MSFW	x						
House Finch	*Carpodacus mexicana*	YLB	x	x		x			x
Pine Siskin	*Carduelis pinus*	MYL	x						
American Goldfinch	*C. tristis*	MSuW	x	x					
Lesser Goldfinch	*C. psaltria*	YL	x	x					
Rufous-sided Towhee	*Pipilio erythrothalmus*	YL	x	x					
Lark Bunting	*Calamospiza melanocorys*	MSuFWB	x		x		x	x	
Lark Sparrow	*Chondestes grammacus*	MSSuB	x	x	x	x	x	x	
Cassin's Sparrow	*Aimophila cassinii*	YLB			x	x	x	x	
Dark-eyed Junco	*Junco hyemalis*	MSFW	x						
Tree Sparrow	*Spizella arborea*	MFW	x	x			x		
Clay-colored Sparrow	*S. pallida*	MSuF	x						
Brewer's Sparrow	*S. breweri*	MSSuWB	x		x	x	x		
White-crowned Sparrow	*Zonotrichia leucophrys*	MYL	x	x			x		
White-throated Sparrow	*Z. albicollis*	MSFW	x		x				
Lincoln's Sparrow	*Melospiza lincolnii*	MSFW	x	x					
Song Sparrow	*M. melodia*	MYL	x						
Chestnut-collared Longspur	*Calcarius ornatus*	MSFW						x	

[1]Includes shinnery-oak and sand sage dune.

[2]American Ornithology Union Blue-listed.

[3]Includes Audubon's Warbler

M = Migratory into, out of, or through area.
B = Breeding record in area.
S = Spring records.
Su = Summer records.
F = Autumn records.
W = Winter records.
YL = Records throughout year.

1214-1

Table 3.3.2.6-3. Mammalian fauna of the High Plains of Texas and New Mexico by habitat type.

COMMON NAME	SPECIES TYPE	HABITAT TYPE						
		RIPARIAN	CANYON UPLAND	DESERT SCRUB	DUNE SCRIB[4]	MESQUITE GRASS	SHORTGRASS	AGRICULTURE
Opossum								
Opossum	*Didelphis virginianus*	X	X					
Shrews								
Desert Shrew	*Notiosorex crawfordi*		X	X				
Bats								
Cave Myotis	*Myotis velifer*	X						
Long-legged Myotis	*M. volans*	X						
Western Pipistrelle	*Pipistrellus hesperus*	X						
Townsend's Big-eared Bat	*Plecotus townsendi*	X						
Pallid Bat	*Antrozous pallidus*	X						X
Brazilian Freetailed Bat	*Tadarida brasiliensis*	X						X
Big Free-tailed Bat	*T. macrotis*	X						
Pocketed Free-tailed Bat	*T. femorosacca*	X						
Armadillos								
Armadillo	*Dasypus novemcinctus*	X						
Rabbits								
Black-tail Jackrabbit	*Lepus californicus*	X		X	X		X	
Desert Cottontail[3]	*Sylvilagus audubonii*	X	X	X	X	X		X
Eastern Cottontail[3]	*S. floridanus*	X					X	X
Rodents								
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*						X	X
Spotted Ground Squirrel	*S. spilosoma*		X		X	X	X	
Black-tailed Prairie Dog	*Cynomus ludovicianus*					X	X	
Plains Pocket Gopher	*Geomus bursarius*	X			X	X	X	X
Desert Pocket Gopher	*G. arenarius*		X	X				
Yellow-faced Pocket Gopher	*Pappogeomys castanops*						X	X
Silky Pocket Mouse	*Perognathus flavus*	X	X	X	X	X	X	
Plains Pocket Mouse	*P. flavescens*		X	X	X			
Merriam's Pocket Mouse	*P. Merriami*		X	X			X	
Hispid Pocket Mouse	*P. hispidis*	X	X	X				
Ord's Kangaroo Rat	*Dipodomys ordi*	X		X	X			
Beaver[1]	*Castor canadensis*	X						
Plains Harvest Mouse	*Reithrodontomys montanus*		X	X		X	X	X
Western Harvest Mouse	*R. megalotis*	X				X	X	X
Deer Mouse	*Peromyscus maniculatus*	X	X	X	X	X	X	X
White-Footed Mouse	*P. leucopus*	X					X	X
Brush Mouse	*P. boylii*	X	X	X				
Rock Mouse	*P. difficilis*		X	X				
Northern Grasshopper Mouse	*Onychomys leucogaster*		X	X	X	X	X	
Hispid Cotton Rat	*Sigmodon hispidis*	X						X
Southern Plains Woodrat	*Neotoma micropus*	X		X				
White-throated Woodrat	*N. albigula*	X	X	X				
Norway Rat	*Rattus norvegicus*	X						X
House Mouse	*Mus musculus*	X						X
Porcupine	*Erethizon dorsatum*	X	X	X				
Carnivores								
Coyote[2]	*Canis latrans*	X	X	X	X	X	X	
Swift Fox	*Vulpes velox*						X	
Gray Fox[1]	*Urocyon cinereoargenteus*	X	X	X				
Racoon[1]	*Procyon lotor*	X	X	X				
Long-tailed Weasel[1]	*Mustela frenata*	X	X	X				
Badger[1]	*Taxidea taxus*				X		X	
Spotted Skunk	*Spilogale gracilis*	X						
Striped Skunk	*Mephitis mephitis*		X	X	X	X	X	
Bobcat[1,2]	*Felis rufus*	X	X	X			X	
Hoofed Animals								
Mule Deer[3]	*Odocoileus hemionus*	X	X	X	X			
White-tail Deer[3]	*O. virginianus*		X		X			
Pronghorn[3]	*Antilocapra americana*			X			X	

[1]Regulated as a furbearer

[2]Regulated as a predator.

[3]Regulated as a game animal.

[4]Includes shinnery-oak and sand sage dunes.

Sources: Davis, 1974, Findley, et al., 1975

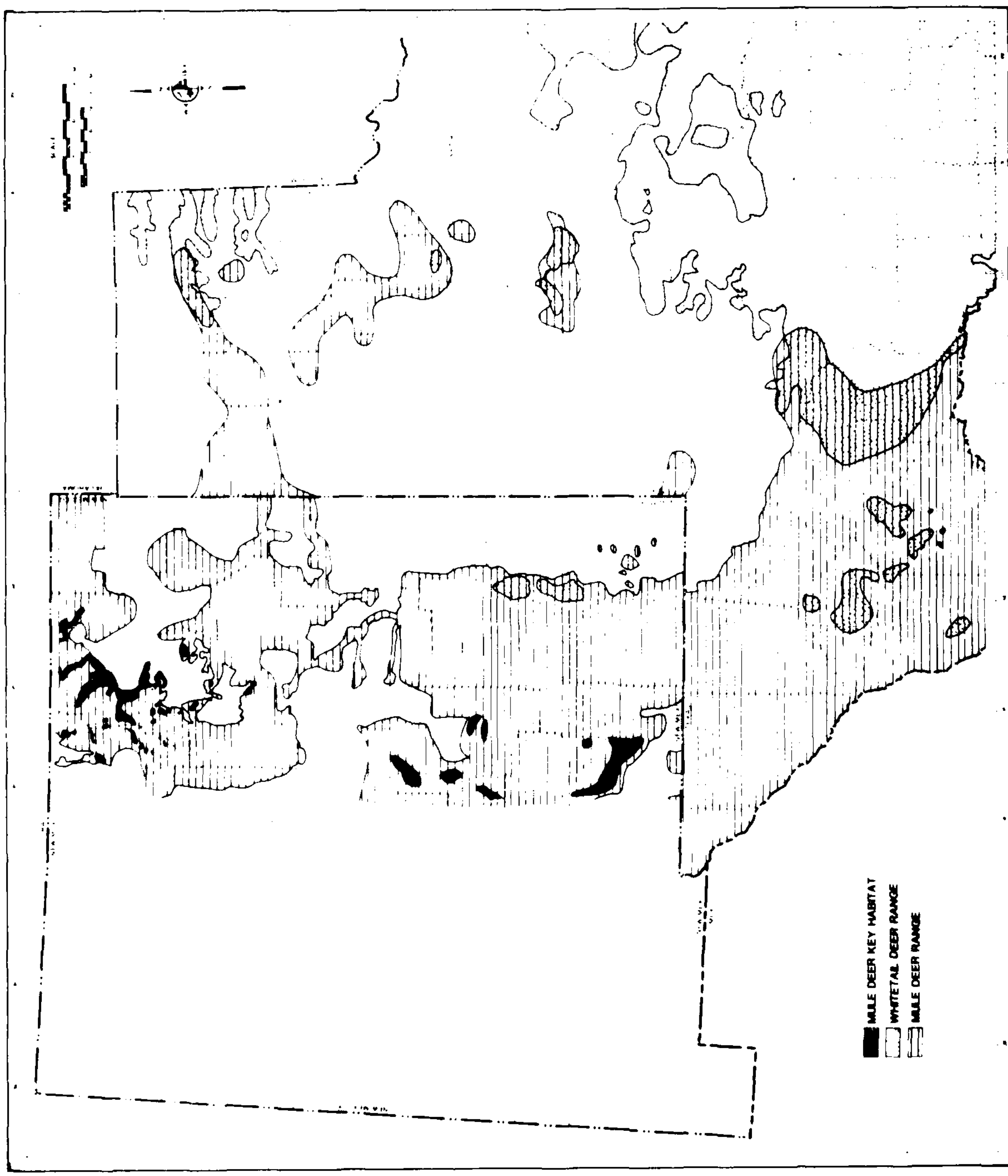

Figure 3.3.2.6-1. Mule deer and white tailed deer distributions in Texas and New Mexico.

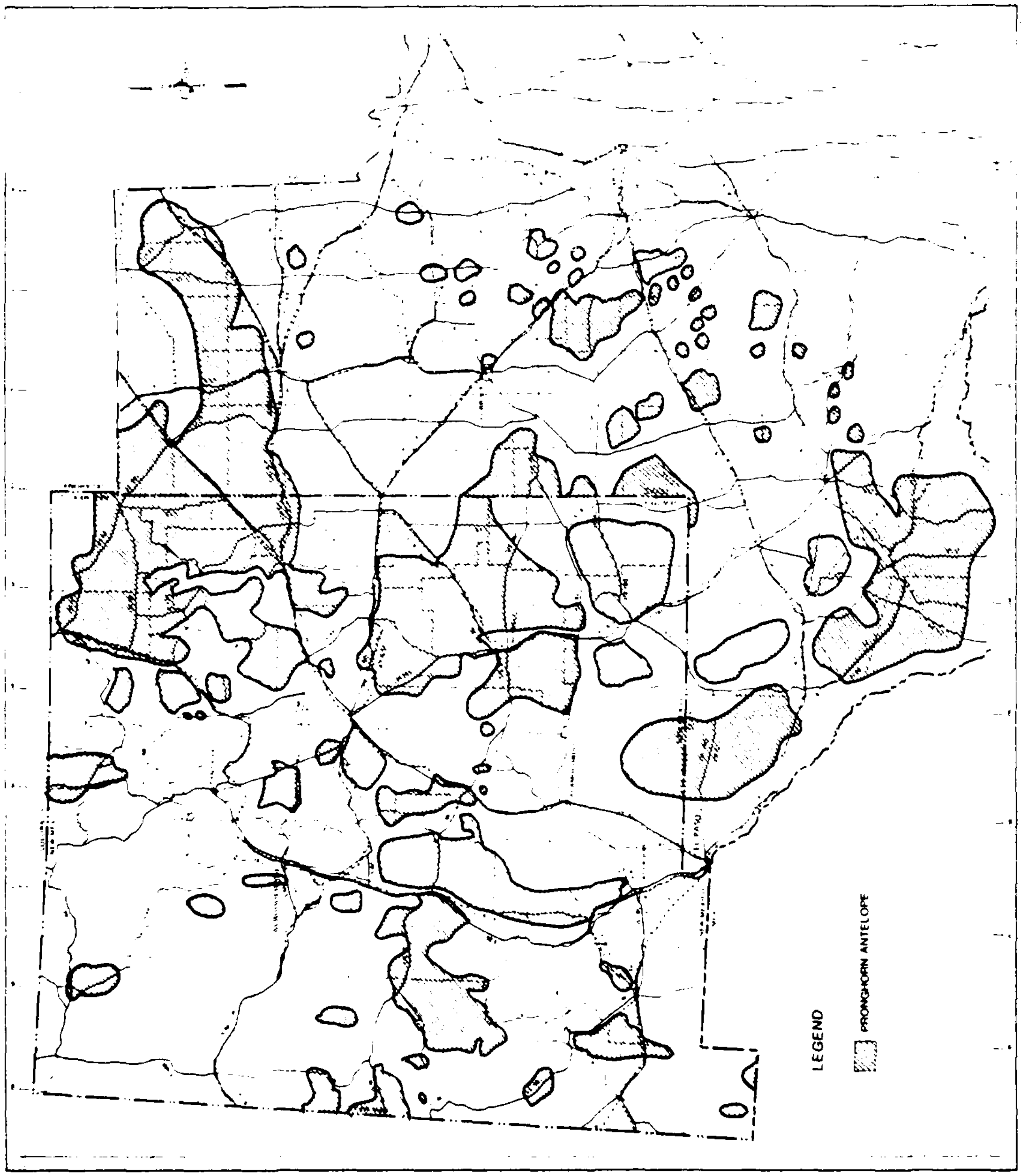

Figure 3.3.2.6-2. Pronghorn antelope range in Texas and New Mexico.

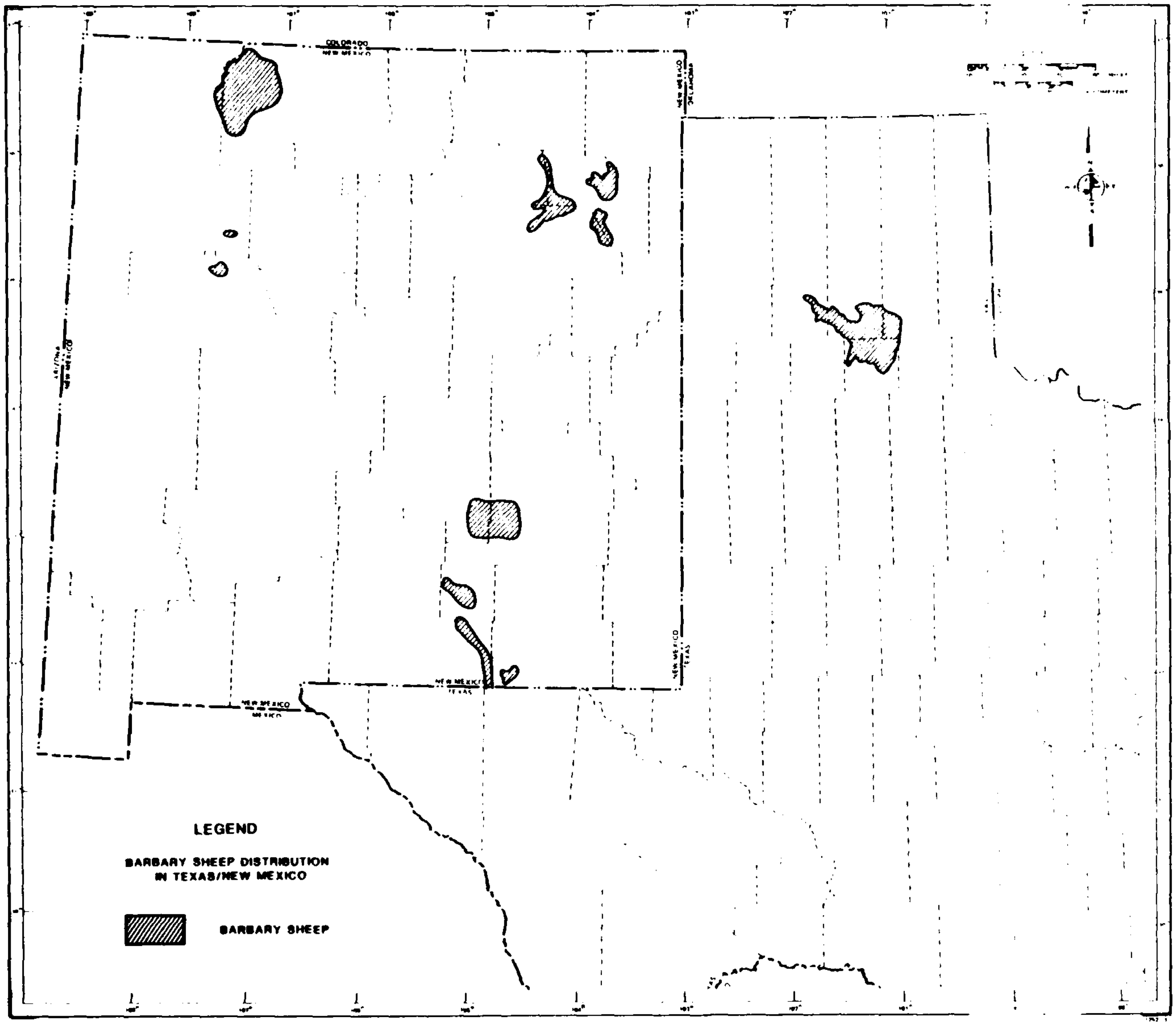

Figure 3.3.2.6-3. Barbary sheep distribution in Texas and New Mexico.

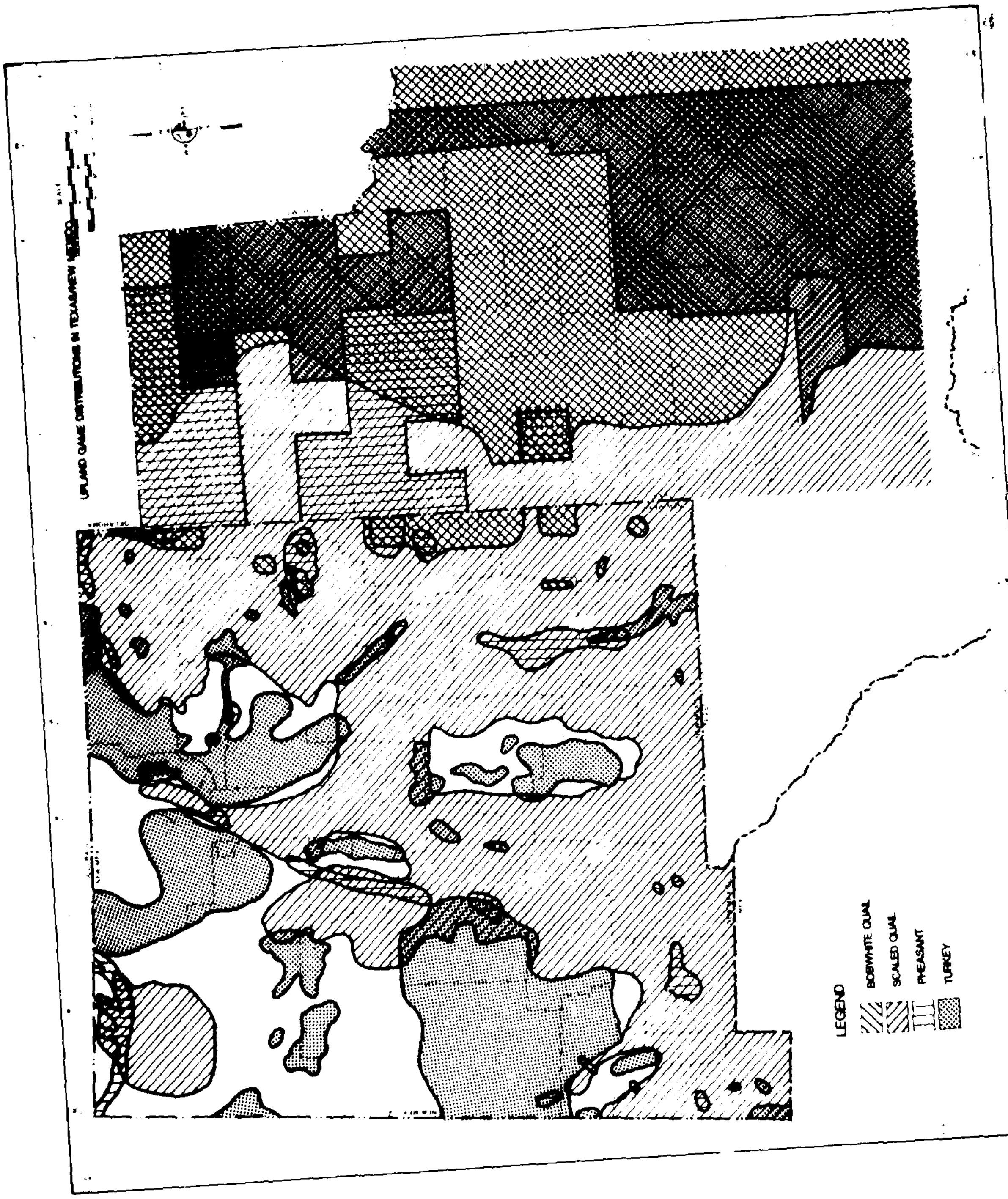

Figure 3.3.2.6-4. Upland game distributions in Texas and New Mexico.

Wildlife Species (3.3.2.8.2)

Three federally protected and 12 state-protected birds occur in the area. Randall County is a stopover point along the Canada-Aransas migratory route for the federally protected whooping crane. One federally protected mammal -- the black-footed ferret -- may live in prairie dog towns in the study area but is probably extirpated. A complete list and map of endangered and threatened animal species is provided in Table 3.3.2.8-2 and Figure 3.3.2.8-2, respectively.

Aquatic Species (3.3.2.8.3)

Protected fish occur mostly in the Pecos River near Roswell, Fort Sumner, and Santa Rosa, in the Canadian River near the Texas border, and in Ute Creek near Mosquero (Figure 3.3.2.8-2). Thirteen fish and two frogs which are state protected as well as one federally protected fish (the Pecos gambusia) may occur in or near the study area. Seven state-protected reptiles are present.

Wilderness and Significant Natural Areas (3.3.2.9)

Wilderness (3.3.2.9.1)

USFWS-managed Salt Creek Wilderness within the Bitter Lakes National Wildlife Refuge, New Mexico, has been designated a wilderness area by Congress. Potential wilderness areas within the proposed siting region include Sabinosa and Mescalero Sands (Figure 3.3.2.9-1), both of which are designated wilderness study areas.

Significant Natural Areas (3.3.2.9.2)

Significant natural areas within or near the area are the National Grasslands, six national wildlife refuges, two national monuments, 14 natural landmarks and two national grassland leased in blocks for rangeland (Figure 3.3.2.9-1).

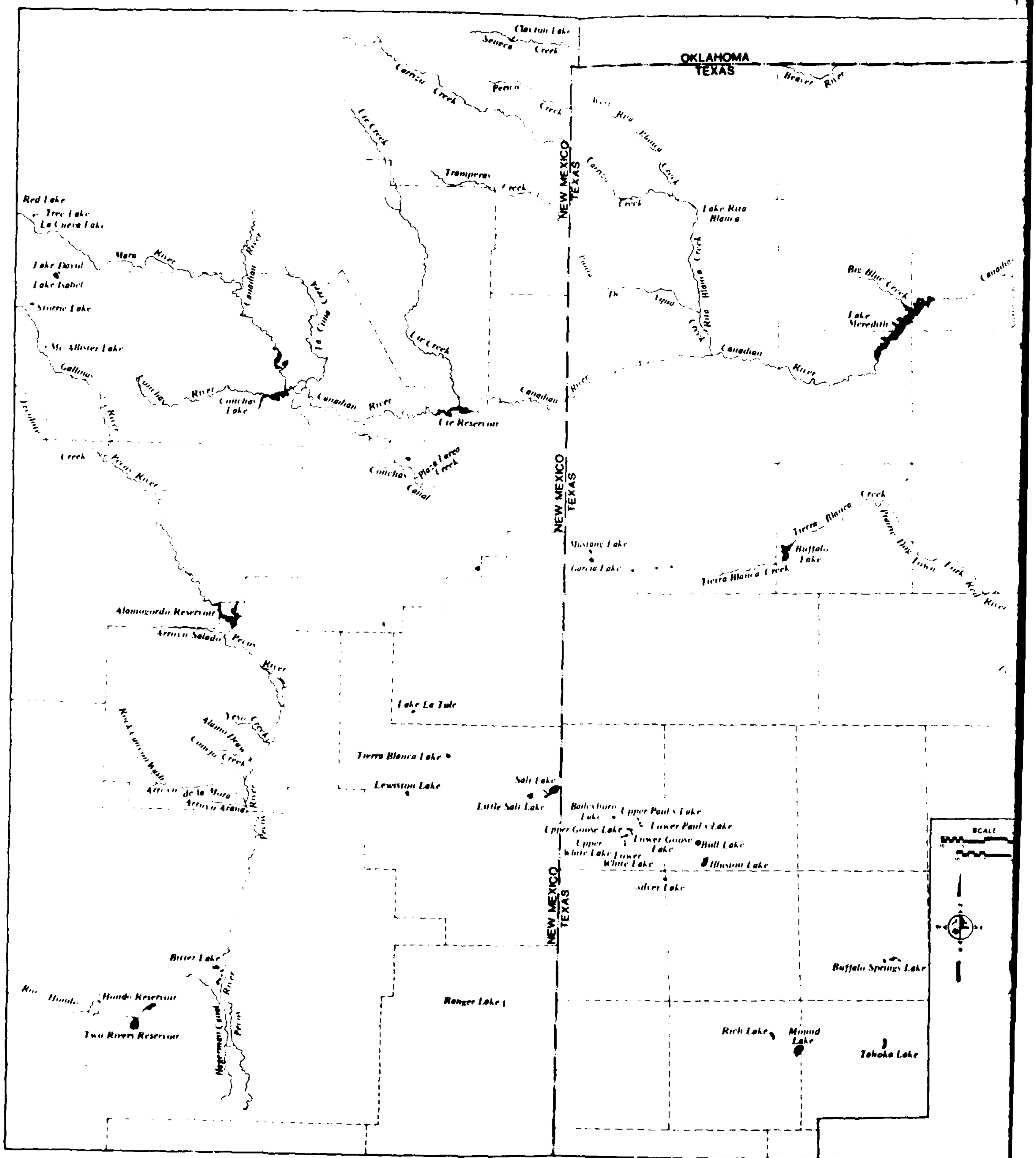

Figure 3.3.2.7-1. Water bodie
study area

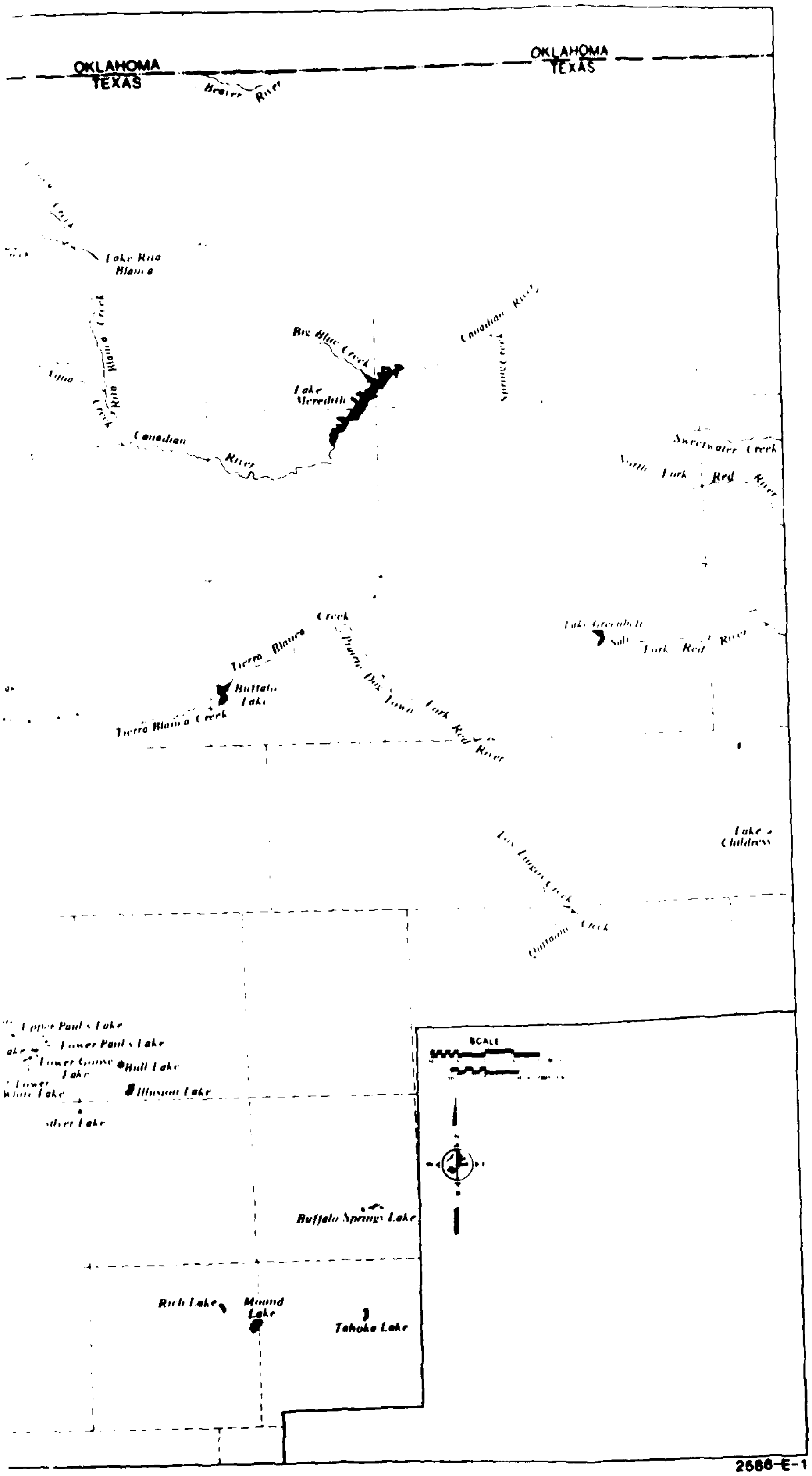

Figure 3.3.2.7-1. Water bodies and major creeks in the Texas/New Mexico study area.

2

Table 3.3.2.7-1. Fishes of the Texas/New Mexico study area.

SPECIES NAME	COMMON NAME	STATUS	DRAINAGE P[1]	C[2]	R[3]
Lepisosteus spatula	alligator gar	S.C			X
L. osseus	longnose gar	S.C			X
Dorosoma cepedianum	gizzard shad		X	X	X
Esox lucius	northern pike	S		X	X
Hiodon alosoides	goldeye			X	X
Astyanax mexicanus	Mexican tetra		X	X	
Cycleptus elongatus	blue sucker		X		X
Ictiobus bubalus	smallmouth buffalo	S.C	X		X
I. cyprinellus	bigmouth buffalo	S.C			X
I. niger	black buffalo		X		X
Carpiodes carpio	river carpsucker	C	X	X	X
Catostomus commersoni	white sucker		X	X	
Cyprinus carpio	carp	S.C	X	X	X
Gila nigrescens	Rio Grande Chub		X	X	
Chrosomus eruthrogaster	redbelly dace			X	
Semotilus atromaculatus	creek chub		X	X	
Phenacobius mirabilis	suckermouth minnow			X	
Dionda episcopa	roundnose		X		
Hybopsis gracilis	flathead chub		X	X	
H. aestivalis	speckled chub		X	X	X
Hybognathus placita	plains minnow		X	X	X
H. nuchalis	silvery minnow				X
Pimephalus vigilas	bullhead minnow	C			X
P. promelas	fathead minnow	C	X	X	X
Campostoma anomalus	soneroller		X	X	X
Carassius auratus	goldfish			X	X
Notropis jamaranus	Rio Grande shiner		X		
N. lutrensis	red shiner	C	X	X	X
N. stramineus	sand shiner	C	X	X	X
N. girardi	Arkansas River shiner			X	X
N. percobromus	plains shiner				X
N. oxyrhynchus	sharpnose shiner			X	
N. shumardi	silverband shiner			X	
N. blennius	river shiner			X	X
N. potteri	chub shiner			X	X
N. buccula	smalleye shiner			X	
N. venustus	blacktail shiner	C		X	
N. volucellus	mimic shiner			X	
N. buchanani	ghost shiner			X	
Notemigonus chrysoleucas	golden shiner	C		X	X
Ictalurus punctatus	channel catfish	S.C	X	X	X
I. furcatus	blue catfish	S.C	X	X	X
I. melas	black bullhead	S.C	X	X	X
I. natalis	yellow bullhead	S.C	X	X	X
I. lupus	headwater catfish		X		
Noturus gyrinus	tadpole madtom			X	
Pylodictis olivaris	flathead catfish		X	X	X
Anguilla rostrata	American eel		X		
Fundulus kansae	plains killifish		X	X	X
F. zebrinus	southwestern killifish		X		
Lucania parva	rainwater killifish		X		
Cyprinodon rubrofluviatilis	Red River pupfish			X	X
C. sp.	Pecos pupfish		X		
Gambusia affinis	mosquitofish		X	X	
G. nobilis	Pecos gambusia		X		
Morone chrysops	white bass	C		X	X
Micropterus salmoides	largemouth bass	S			
M. punctulatus	spotted bass	S	X		X
Lepomis gulosus	warmouth	S	X	X	
L. auritus	yellowbelly sunfish	S			X
L. cyanellus	green sunfish	S		X	X
L. punctatus	spotted sunfish			X	
L. microlophus	redear sunfish	S	X	X	X
L. macrochirus	bluegill	S	X	X	X
L. humilis	orange-spotted sunfish	S		X	X
L. megalotis	longear sunfish	S	X	X	X
Pomoxis annularis	white crappie	S	X	X	
P. nigromaculatus	black crappie	S	X		
Perca flavescans	yellow perch	S	X		
Etheostoma lepidum	greenthroat darter		X		
E. spectabile	orangethroat darter			X	
Stizostedion vitreum	walleye			X	
Percina caprodes	logperch			X	X
Percina macrolepida	bigscale logperch		X		
Aplodinotus grunniens	freshwater drum	S.C		X	X
Moxostoma congestum	gray redhorse		X		X
N. bairdi	Red River shiner				X

1199 A

P = Pecos

C = Canadian and Arkansas

R = Red

S = Sport; C = Commercial

Table 3.3.2.8-1. Rare and protected plants of the Texas/New Mexico High Plains.

SPECIES	COMMON NAME	FAMILY	STATUS*	KNOWN DISTRIBUTION	HABITAT	FLOWERING TIME	REMARKS AND REFERENCES
Asclepias [illegible] Torr.	Bracted milkweed	Asclepiadaceae	RE(TX)	Oldham, Hartley, Counties, TX; NM	Dry gravelly hills, prairie flats, arroyos in high plains	Apr-May	Rare in TX, reported from NM
[illegible]	[illegible] sedge	Cyperaceae	RE(TX)	[illegible], Randall Co., TX	Seeps on shaded hillsides	June	Rare in TX; reported from NM, widespread in U.S.
Cypripedium [illegible] var. pubescens [illegible] Correll	Yellow lady's slipper	Orchidaceae	RE(TX)	Bailey Co., TX;NM	Playa lake edges	Apr-June	Probably extirpated; not seen since 19[illegible]; widespread in eastern U.S. to Rockies.[1]
[illegible] Benson	Kuenzler's barrel cactus	Cactaceae	SE(NM) (FCE)	Rio Elk Cyn., NM[2]	Limestone outcrops	May	Apparent local endemic
Eriogonum correllii Reveal	Correll's buckwheat	Polygonaceae	RE(TX)	Hartley, Briscoe, Armstrong, counties Texas	Clay mounds, caprock, rocky ledges	July-Oct	TX high plains endemic
Juniperus pinchotii Sudw.	Redberry juniper	Cupressaceae	PI(NM)	Texas Panhandle, West Texas, adjacent NM	Dry hillsides and canyons	Spring	Widespread in Texas, rare in NM; one stand near Roswell on Mescalero Ridge
Juniperus scopulorum Sarg.	Rocky Mt. juniper	Cupressaceae	RD(TX)	High plains + Trans-Pecos, TX;NM	Cedar breaks, rocky canyon areas	Spring	Widespread in Rockies, western U.S. north of TX; status in [illegible] undocumented, but probably common
Limonium limbatum [illegible]	[illegible]	Plumbaginaceae	RD(NM)	Panhandle, Trans-Pecos, TX; widespread in NM	Saline flats	June-Aug	Widespread in TX, NM in appropriate habitat
[illegible] (Gray) Gray	Annual skeleton plant	Asteraceae	RE(TX)	High plains, TX - NM	Loose sandy soils	June-Oct	Probably extinct in TX; not known from NM
Muhlenbergia pungens Thurb.	Sandhill muhly	Poaceae	RE(TX)	Hartley Co., TX; NM	Loose sandy soils, dunes, sandy clay hills	Late summer	Rare in TX; reported from NM; high plains in adjacent states
Oryzopsis micrantha (Trin. & Rupr.) Thurb.	Littleseed ricegrass	Poaceae	RE(TX)	Deaf Smith, Culberson, [illegible] TX;NM	Canyons in high plains	Summer	Probably extirpated in TX; reported from NM
Pellaea glabella	Smooth cliff brake	Polypodiaceae	RE(TX)	[illegible], [illegible] TX	Crevices in limestone, calcareous soils		Widely distributed in eastern United States

RE = recommended endangered; SE = state endangered; RD = recommended delisted; PI = [illegible]; FCE = [illegible] endangered, federally listed

[1] Rowell, C. M., Jr. 1971. "Vascular plants of the playa lakes of the Texas Panhandle and South Plains", Southwestern Naturalist 15(4): [illegible].

[2] [illegible] and southwest of study area proper — not mapped

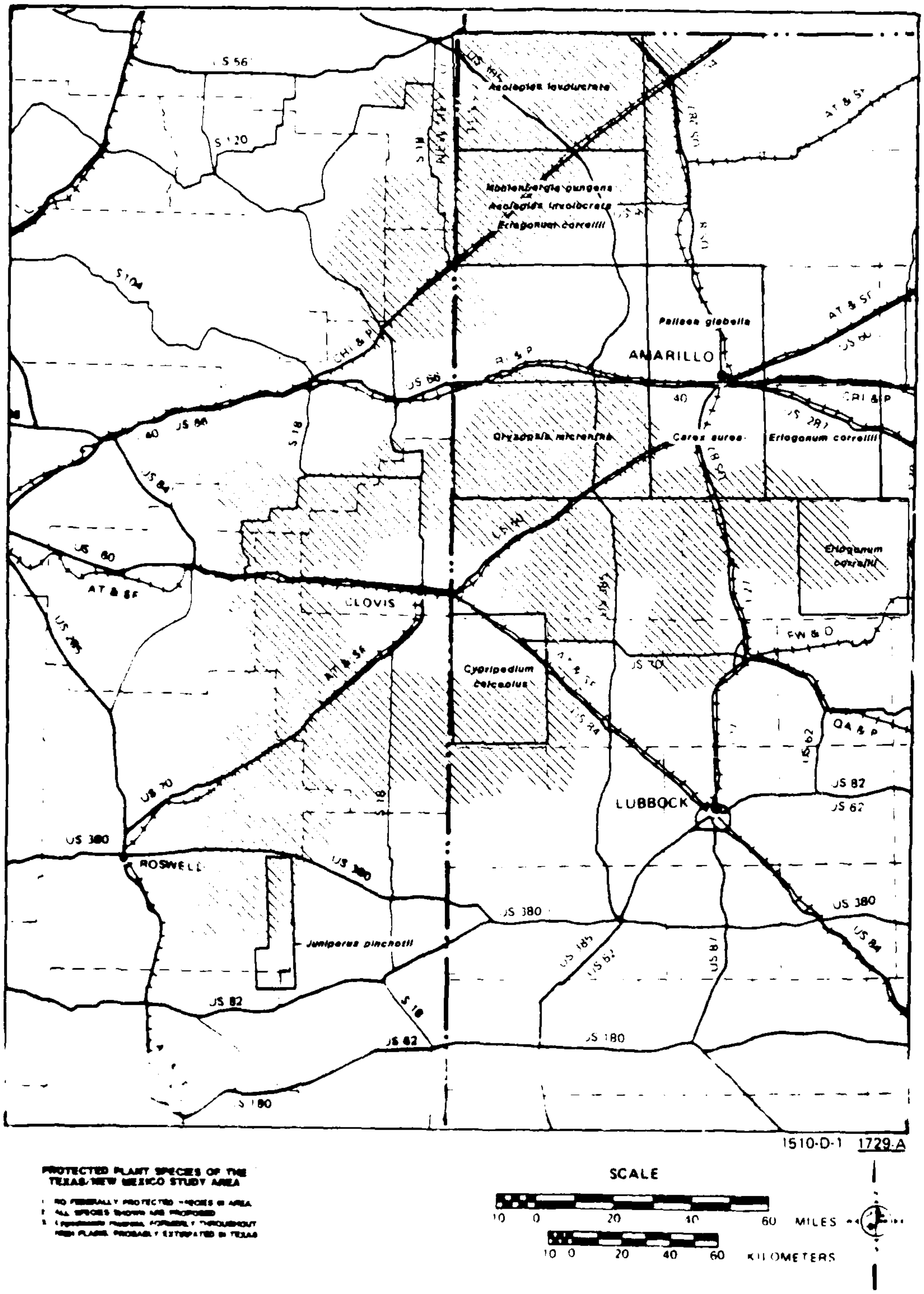

Figure 3.3.2.8-1. Protected plant species located in and near the Texas/New Mexico geotechnically suitable area (hatched).

Table 3.3.2.8-2. Endangered and threatened fish and wildlife in the Texas/New Mexico High Plains area, (Page 1 of 2).

SPECIES	FEDERAL	TEXAS	NEW MEXICO	STATUS	HABITAT
MAMMALS					
Black-footed Ferret (*Mustela nigripes*)	E	E	E	Resident	Prairie Dog Towns
BIRDS					
Olivaceous Cormorant (*Phalacrocorax olivaceus*)			T	Occasional[1]	Lakes, Reservoirs
Little Blue Heron (*Florida caerulea*)			T	Occasional Breeder	River Marshes
Mississippi Kite (*Ictinia mississippiensis*)			T	Occasional Breeder	Riparian Woods
Black Hawk (*Buteogallus anthracinus anthracinus*)			E	Casual	Riparian Woods
Zone-tailed Hawk (*Buteo albonotatus*)		T	T	Occasional Breeder	Canyons
Bald Eagle (*Haliaeetus leucocephalus*)	E	E	E	Casual	River Valleys
Osprey (*Pandion haliaetus carolinensis*)		T	T	Occasional Breeder	River Valleys
American Peregrine Falcon (*Falco peregrinus anatum*)	E	E	E	Casual	All habitats
Whooping Crane (*Grus americana*)	E	E	T	Casual[2]	River Valleys and Marshes
Interior Least Tern (*Sterna albifrons athalassos*)		E	T	Occasional Breeder	River Valleys
Red-headed Woodpecker (*Melanerpes erythrocephalus caurinus*)			T	Occasional Breeder	Riparian Woods
White-faced Ibis (*Plegadis chihi*)		T		Casual	River Valleys
Bell's Vireo (*Vireo bellii*)			T	Occasional Breeder	Riparian Shrubs, Woods
Baird's Sparrow (*Ammodramus bairdi*)			T	Winter Resident	Grasslands
McCown's Longspur (*Calcarius mccowni*)			T	Casual	Shortgrass
REPTILES					
Central Plains Milk Snake (*Lampropeltis triangulum gentilis*)		T		Resident	Grassland
Pecos Western Ribbon Snake (*Thamnophis proximus diabolicus*)			T	Resident	Edges of Ponds, Streams
Texas Horned Lizard (*Phrynosoma cornutum*)			T	Resident	In Open Terrain
Sanddune Sagebrush Lizard (*Sceloporus graciosus arenicolus*)			T	Resident	Active Sand Dunes
Texas Slider (*Chrysemys concinna texana*)			T	Resident	Rivers, Ponds
Spiny Softshell Turtle (*Trionyx spiniferus hartwegi*)			T	Resident	Rivers, Reservoirs
Smooth Softshell Turtle (*Trionyx muticus*)			T	Resident	Rivers, Reservoirs

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Table 3.3.2.8-2. Endangered and threatened fish and wildlife in the Texas/New Mexico High Plains area, (Page 2 of 2).

SPECIES	FEDERAL	TEXAS	NEW MEXICO	STATUS	HABITAT
AMPHIBIANS					
Eastern Barking Frog (*Hylactophryne augusti latrans*)			T	Resident	Limestone Regions
Blanchard's Cricket Frog (*Acris crepitans blanchardi*)			T	Resident	Pond, Stream Edges
FISHES					
American Eel (*Anguilla rostrata*)			E	Resident[3]	Rivers, Streams
Blue Sucker (*Cycleptus elongatus*)		T	E	Resident	Large Rivers
Gray Redhorse (*Moxostoma congestum*)			E	Resident	Rivers, Large Streams
Mexican Tetra (*Astyanax mexicanus*)			T	Resident	All Water Bodies
Roundnose Minnow (*Dionda episcopa*)			T	Resident	Creeks, Springs
Canadian Speckled Dace (*Hybopsis aestivalis tetranemus*)			T	Resident	Rivers (Below Ute Dam)
Arkansas River Shiner (*Notropis girardi*)			E	Resident	Rivers, Streams
Silverband Shiner (*Notropis shumardi*)			E	Resident	Large Rivers
Suckermouth Minnow (*Phenacobius mirabilis*)			T	Resident	Streams with Gravel Bottoms
Pecos Pupfish (*Cyprinodon* sp.)			T	Resident	Springs, Sinks, Ponds
Rainwater Killifish (*Lucania parva*)			T	Resident	Swamps
Greenthroat Darter (*Etheostoma lepidum*)			T	Resident	Vegetated Springs
Bigscale Logperch (*Percina macrolepida*)			T	Resident	Small Lakes, Rocky Silt Bottoms
Pecos Gambusia (*Gambusia nobilis*)	E		E	Resident	Sinkholes, Springs (Known from 8 localities)

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E = Endangered

T = Threatened

[1]Breeds west of study area.

[2]Winters outside of area.

[3]Possibly extirpated.

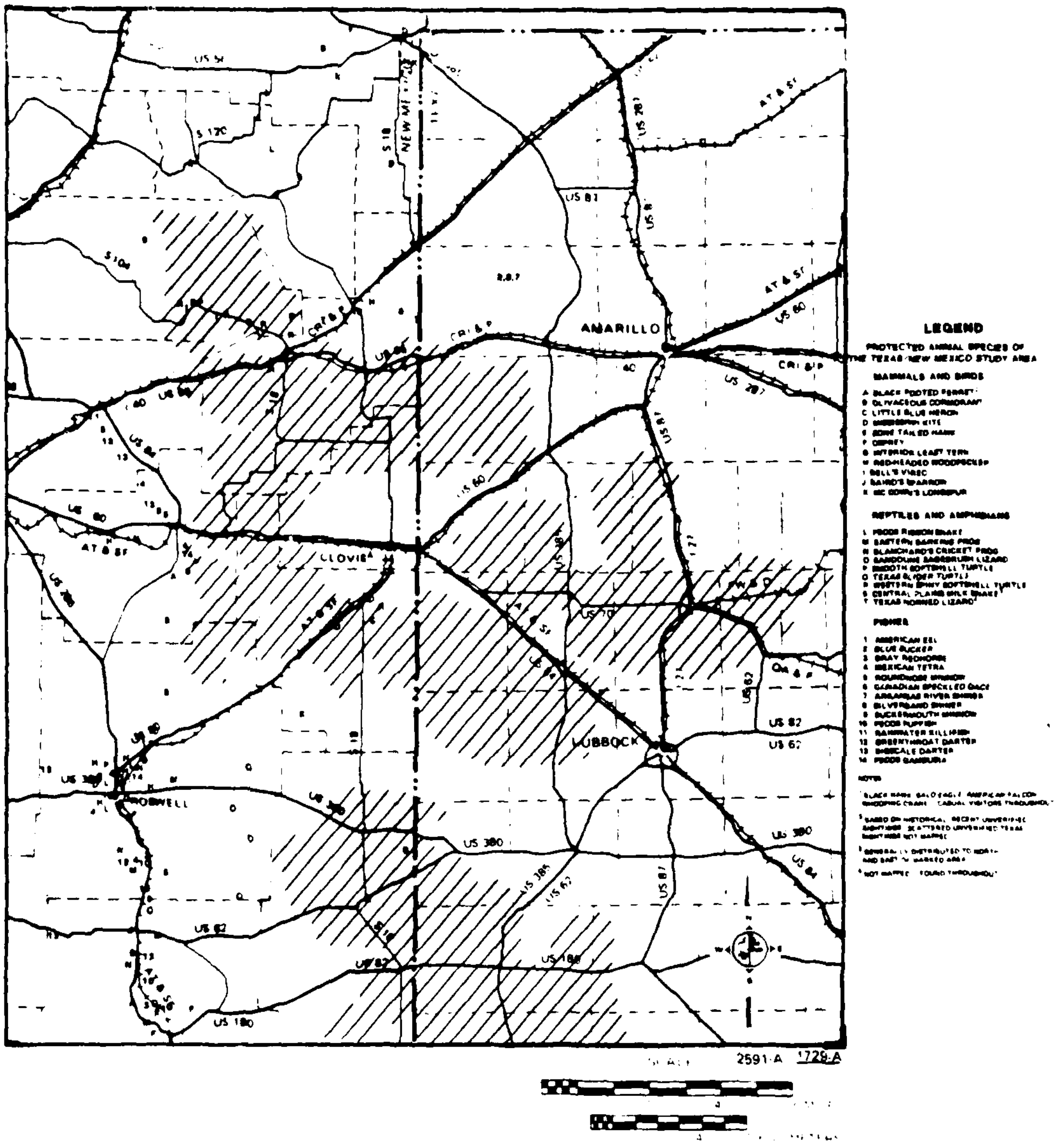


Figure 3.3.2.8-2. Protected animal species in and near the Texas/New Mexico geotechnically suitable area (hatched).

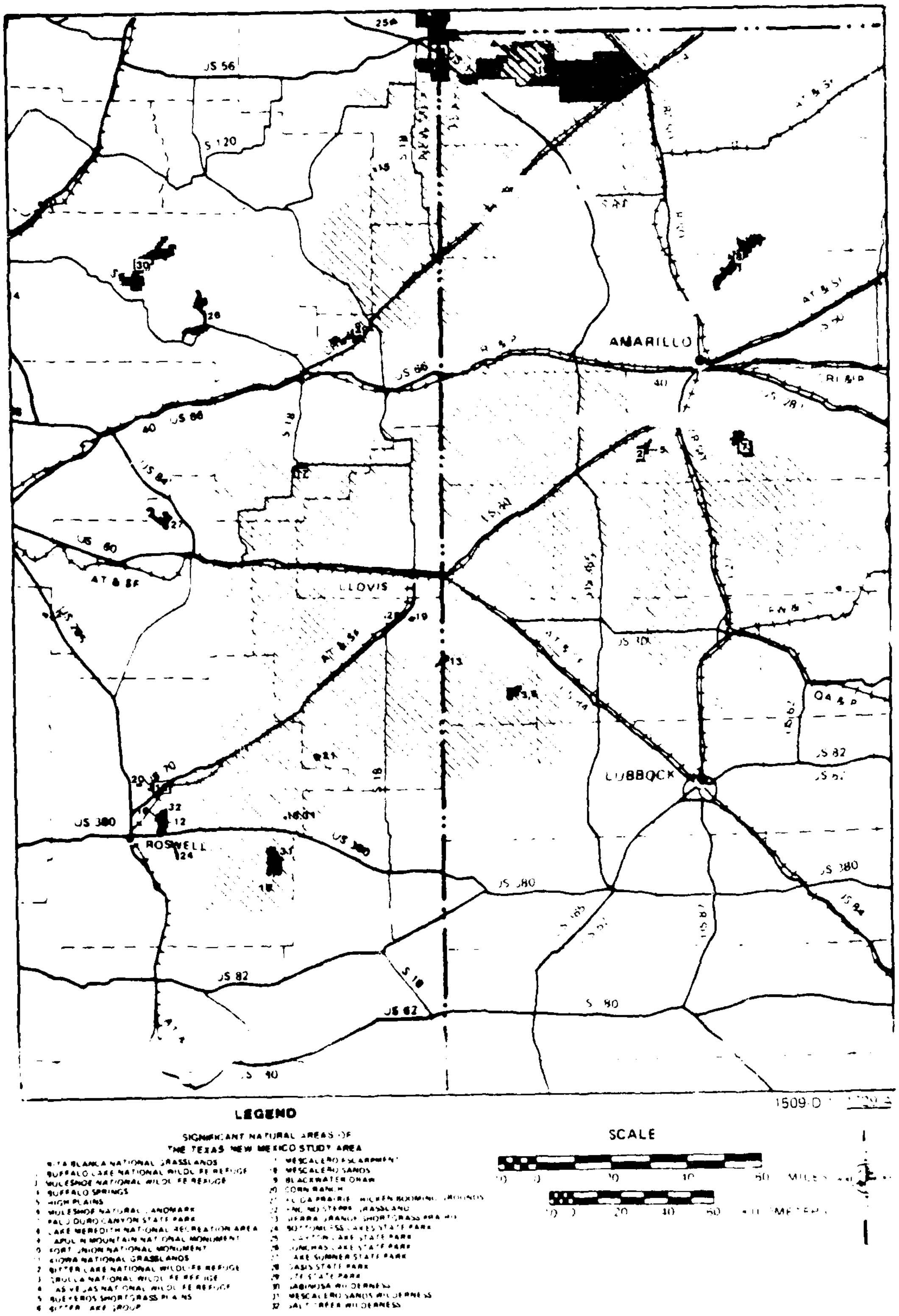
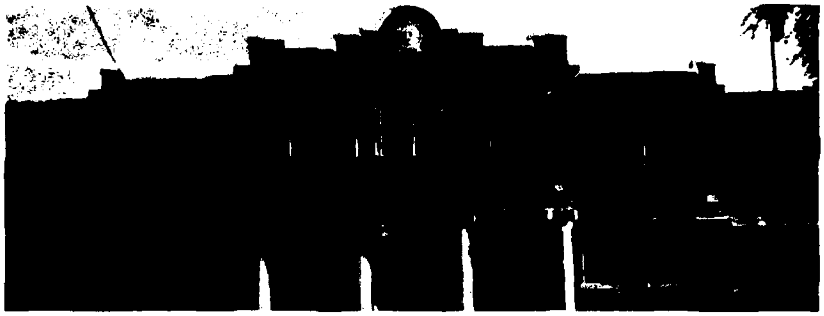


Figure 3.3.2.9-1. Existing and proposed wilderness and significant natural areas in and near the Texas/New Mexico geotechnically suitable area (hatched).

Texas/New Mexico Human Environment



HUMAN ENVIRONMENT (3.3.3)

The designated Texas/New Mexico region of influence (ROI) is shown in Figure 3.3.3-1. It includes the Texas counties of Bailey, Castro, Cochran, Dallam, Deaf Smith, Hale, Hartley, Hockley, Lamb, Lubbock, Moore, Oldham, Parmer, Potter, Randall, Sherman, and Swisher, and the New Mexico counties of Chaves, Curry, De Baca, Harding, Quay, Roosevelt, and Union. Geographic areas analyzed other than the ROI include areas of analysis (AOA) and potential base site locations. Attributes which cannot be logically evaluated at the county level (e.g., air quality) are explicitly defined when baseline data are presented. Potential base sites are located in the vicinity of Clovis, New Mexico, and Dalhart, Texas.

Employment (3.3.3.1)

During the past decade, employment rates in both Texas and New Mexico have been above the national average. Most of the unemployment in both states has been in the large metropolitan areas. In the Panhandle and South Plains regions of Texas, the unemployment rate has been below both the state and national averages. This is also the case in Curry County, New Mexico. This favorable employment condition is expected to continue as both states anticipate growth of local markets as a result of population influxes.

Texas

The state of Texas possesses the following economic characteristics:

- A growth rate more than twice that of the United States as a whole
- A predominantly metropolitan and young population
- An economy that is well distributed across diverse economic sectors, with greatest emphasis in manufacturing and trade
- A low level of unemployment

Tables 3.3.3.1-1 and 3.3.3.1-2 highlight detailed employment characteristics of the Texas ROI. The former table indicates the relative dependence of the region's economy on four sectors--government, comprising 17 percent of total employment in 1976; services, with 15 percent; agriculture, with 11 percent; and manufacturing, the source of 10 percent of 1976 regional employment. The government and services 1976 employment shares in the region were slightly below those for the state and nation, while the agricultural employment share was more than double the corresponding shares for Texas and the U.S. The region's manufacturing employment share was two-thirds that of the state and only one-half that of the nation. Table 3.3.3.1-2 presents nine year employment growth figures and indicates that the Texas ROI has grown at a pace just slightly faster than the nation although the state of Texas has grown at almost double the national rate over the 1967-1976 period. All of the industries experienced growth rates above 2.6 percent per year except the agriculture and government sectors where employment declined in both sectors by 0.6 percent per year between 1967 and 1976.

Figure 3.3.3.1-1 presents historic and projected baseline labor force in the Texas ROI from 1974 to 1994. It shows a sharp increase in the amount of

Table 3.3.3.1-1. Total employment and percent share by major economic sectors for counties in Texas, 1976.

COUNTY	TOTAL EMPLOYMENT	PERCENT OF TOTAL STATE EMPLOYMENT	AGRICULTURE SHARE (PERCENT)	MINING SHARE (PERCENT)	CONSTRUCTION SHARE (PERCENT)	MANUFACTURING SHARE (PERCENT)	SERVICES SHARE (PERCENT)	GOVERNMENT SHARE (PERCENT)
Bailey	3,468	0.06	36.9	(D)	1.9	1.3	10.5	11.3
Castro	4,988	0.09	45.1	(D)	3.8	4.6	7.0	14.0
Cochran	2,092	0.04	43.9	1.1	0.9	2.6	9.2	17.8
Dallam	3,475	0.06	29.9	0.1	2.3	3.7	9.1	11.2
Deaf Smith	9,434	0.17	26.2	0.1	4.2	13.7	8.2	11.8
Hale	15,527	0.27	19.5	0.2	2.9	11.2	13.3	14.6
Hartley	1,356	0.02	65.9	0.0	0.0	0.7	10.8	8.1
Hockley	7,761	0.14	21.3	14.3	2.1	2.2	12.2	16.5
Lamb	7,272	0.13	30.6	0.0	2.7	1.8	11.3	12.3
Lubbock	92,404	1.62	3.2	0.1	4.8	11.8	17.5	20.6
Moore	7,075	0.12	15.8	5.6	6.7	15.2	10.5	13.1
Oldham	1,150	0.02	42.8	(D)	3.8	0.0	11.3	16.6
Parmer	5,539	0.10	47.2	0.0	1.6	9.1	7.1	9.3
Potter/Randall	77,108	1.35	2.3	1.4[1]	5.3	11.2	16.9	16.1
Sherman	2,179	0.04	53.6	2.7	2.7	0.8	3.5	9.5
Swisher	4,801	0.08	38.0	(D)	1.0	4.5	7.1	12.8
Texas ROI	245,629	4.30	11.3	1.1[1]	4.4	10.2	15.0	16.8
Total State	5,706,293	100.00	5.1	2.4	5.6	15.0	16.2	18.4
United States	94,685,804		4.5	0.8	3.8	20.1	17.2	18.6

3796-2

[1]Estimated.

[2](D) = Not shown to avoid disclosure of confidential information.

Source: BEA, July 1978.

Table 3.3.3.1-2. Texas employment growth by sector, study area counties, *1967-1976 (Page 1 of 2)*.

COUNTY	TOTAL			AGRICULTURE			MINING		
	1967	1976	Δ[1]	1967	1976	Δ	1967	1976	Δ
Bailey	3,656	3,468	-0.6	1,691	1,281	-3.0	1	(D)	(D)
Castro	3,989	4,988	2.5	2,138	2,250	0.6	0	(D)	(D)
Cochran	2,247	2,092	-0.8	1,056	918	-1.5	114	22	-16.7
Dallam	3,159	3,475	1.1	823	1,038	2.6	1	1	16.7
Deaf Smith	6,524	9,434	4.2	2,346	2,473	0.6	(D)	6	(D)
Hale	13,875	15,527	1.3	3,469	3,033	-1.5	42	28	-4.4
Hartley	857	1,356	5.2	535	894	5.9	0	0	0.0
Hockley	7,256	7,761	0.8	2,391	1,655	-4.0	836	1,109	3.2
Lamb	6,907	7,272	0.6	2,820	2,222	-2.6	(D)	2	(D)
Lubbock	69,990	92,404	3.1	3,823	2,922	-2.9	68	102	4.6
Moore	5,712	7,075	2.4	818	1,116	3.5	232	399	6.2
Oldham	1,037	1,150	1.2	362	444	2.3	(D)	(D)	(D)
Parmer	4,306	5,539	2.8	2,460	2,616	0.7	(D)	0	(D)
Potter/Randall	72,807	77,108	0.6	1,664	1,781	0.8	874	(D)	2.0
Sherman	1,650	2,179	3.1	827	1,167	3.9	21	58	11.9
Swisher	4,584	4,801	0.5	2,008	1,826	-1.1	(D)	(D)	(D)
Texas ROI	208,565	245,629	1.8	29,231	27,636	-0.6	2,189	2,772	2.7
Total State	4,419,612	5,706,293	2.9	328,978	290,915	-1.4	106,136	137,691	2.9
United States	82,506,400	94,685,804	1.5	4,625,000	4,262,804	-0.9	615,000	777,000	2.6

3799-1

Table 3.3.3.1-2. Texas employment growth by sector, study area counties, 1967-1976 (Page 2 of 2).

COUNTY	CONSTRUCTION			MANUFACTURING			SERVICES			GOVERNMENT		
	1967	1976	Δ	1967	1976	Δ	1967	1976	Δ	1967	1976	Δ
Bailey	121	66	-6.5	27	46	6.1	304	364	2.0	360	392	1.0
Castro	130	191	4.4	109	229	8.6	313	317	1.2	100	696	6.3
Cochran	(D)	18	(D)	(D)	51	(D)	148	193	3.0	288	373	2.9
Dallam	94	79	-1.9	151	128	-1.8	422	316	3.2	286	389	3.5
Deaf Smith	182	396	9.0	521	1,292	10.6	607	772	2.7	723	1,110	4.9
Hale	562	449	-2.5	838	1,737	8.4[5]	2,038	2,070	0.2	1,50[illegible]	2,261	4.0
Hartley	(D)	0	(D)	0	9	-	27	146	20.6	96	110	1.5
Hockley	188	165	1.4	103	172	5.9	731	919	2.9	941	1,281	3.6
Lamb	77	196	10.9	127	129	0.2	586	820	-0.5	673	892	3.2
Lubbock	3,242	4,452	3.6	6,061	10,949	6.8	12,435	16,192	3.0	13,910	18,994	3.5
Moore	395	471	2.0	1,175	1,072	-1.9	395	744	7.3	798	929	1.7
Oldham	(D)	39	(D)	0	0	0.0	29	148	19.9	114	172	1.7
Parmer	55	88	5.4	128	503	16.4	366	391	0.7	386	517	[illegible]
Potter/Randall	2,644	4,064	4.9	4,749	8,614	6.8	10,407	13,017	2.5	22,459	12,405	6.1
Sherman	(D)	58	(D)	9	17	7.3	65	77	1.9	192	207	0.8
Swisher	116	49	-9.1	105	218	8.5	295	342	1.7	175	613	2.9
Texas ROI	7,806	10,781	3.7[6]	14,103	25,169	6.6	29,168	36,888	2.6	13,716	11,311	-0.6
Total State	213,973	321,143	4.6	665,385	854,662	2.8	698,176	923,660	3.2	811,575	1,017,289	2.9
United States	3,308,000	3,615,000	1.0	19,504,000	19,026,000	-0.3	12,675,000	16,307,000	2.8	13,924,400	17,633,000	2.7

3799-1

[1]Δ = Average annual growth rate.

[2](D) = Not shown to avoid disclosure of confidential information.

[3](L) = Less than 10 wage and salary jobs.

[4]Rate in doubt because of large number of data points withheld.

[5]— = Undefined.

[6]Estimate

Source: BEA, July 1978

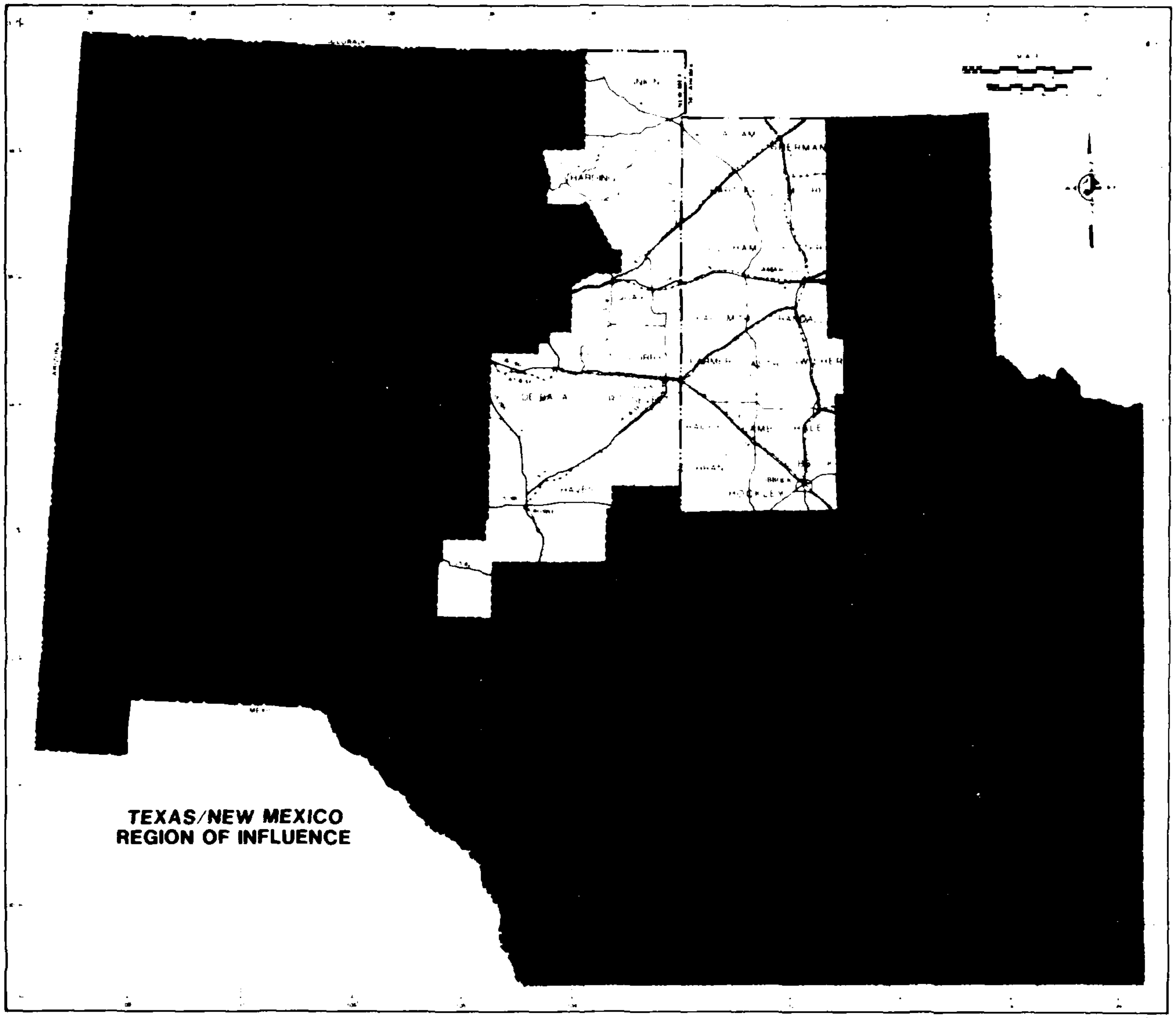


Figure 3.3.3-1. The Texas/New Mexico region of influence (ROI) for the human environment.

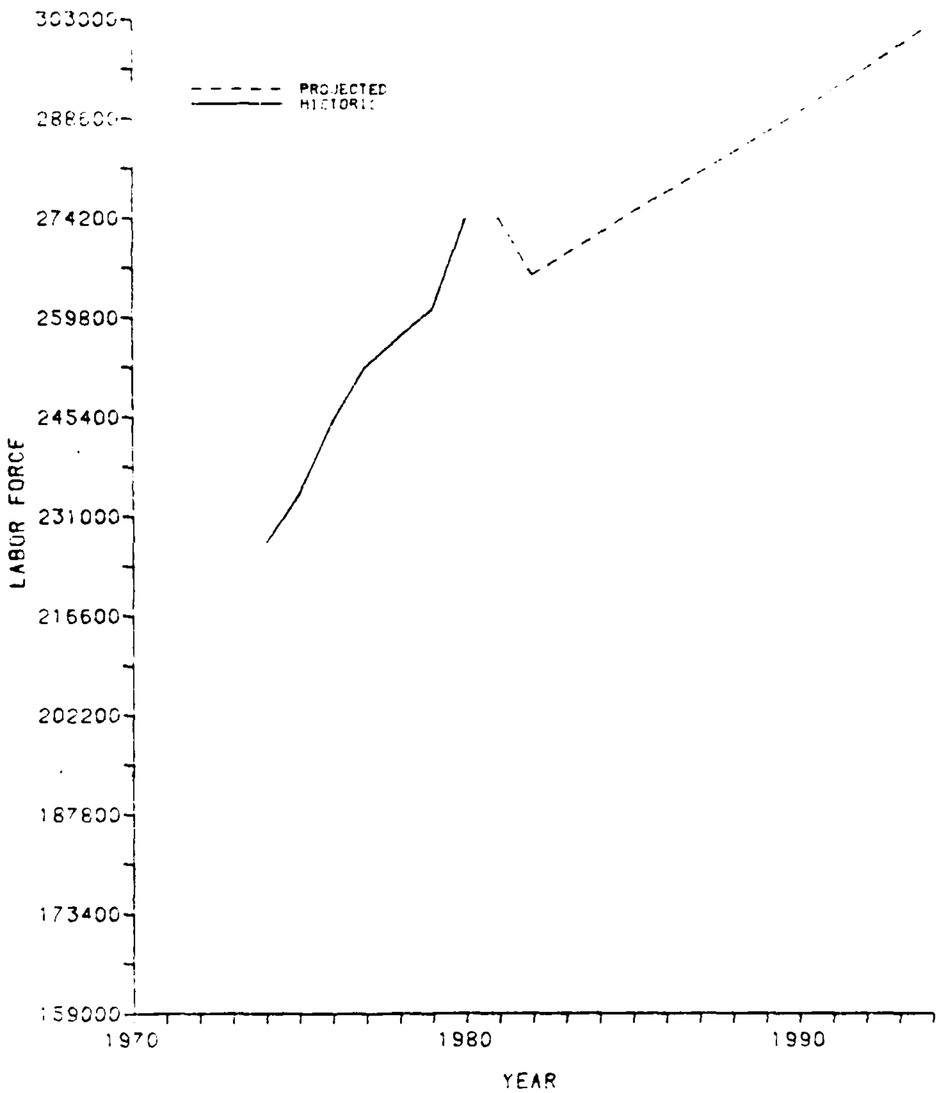


Figure 3.3.3.1-1. Historic and projected baseline labor force in Texas 17-county region.

employable workers from 1974 to 1980, then projects a short decline from 1981 to 1982 and then steady increase through 1994. Figure 3.3.3.1-2 presents the historic and projected rate of unemployment from 1974-1994 in the 17-county ROI. The unemployment rate has remained very close to four percent over the past six years, and is projected to remain at this level through 1994.

New Mexico

In the last half of the 1970s, the economy, population, and employment of New Mexico expanded. But by 1980, inflation had moderated the significant economic improvement of the past few years. Population growth was running at a 1.5 percent annual rate of increase in 1977. Development of the state's energy resources and the attractiveness of sunbelt living have been prime influences in this expansion.

Tables 3.3.3.1-3 and 3.3.3.1-4 highlight detailed employment characteristics of the New Mexico ROI. Tables 3.3.3.1-3 indicates the relative dependence of the region's economy on three sectors--government, comprising 28 percent of total employment in 1977; agriculture, with 13 percent; and services, the source of 12 percent of 1977 regional employment. The ROI government sector employment share is 50 percent greater than that of the nation. The agricultural employment share is three times that of the nation.

Manufacturing and services traditionally dominate a well-balanced economic base; however, in the New Mexico ROI, manufacturing is only one-third, and services only two-thirds that of the corresponding national employment shares.

Table 3.3.3.1-4 presents 10-year employment growth figures and indicates that the New Mexico ROI has grown very little relative to the state as a whole. Employment has increased by only 1.6 percent per year between 1967 and 1977 in the region, but increased by 3.3 percent per year statewide. Government sector employment increased by 3,151 jobs, greater than the total of all the other sectoral employment increases combined; however, its average annual growth rate was still less than both the state and national figures. Both mining and agriculture experienced employment declines over the 1967-1977 period in the New Mexico ROI.

Figure 3.3.3.1-3 presents historic and projected baseline labor force in the New Mexico ROI from 1970-1994. It shows a sharp increase in the amount of employable workers from 1970 to 1980 and projects a slight increase from 1982 to 1994. Figure 3.3.3.1-4 presents historic and projected annual rates of unemployment from 1970 to 1994 in the seven-county ROI. The unemployment rate has decreased slightly over the last decade from around six percent to 4.5 percent, and is projected to remain at this level form 1982 to 1994.

Income and Earnings (3.3.3.2)

Income and earnings trends in Texas indicated growth in all economic sectors during the 1970s. Nearly all sectors approached or exceeded a doubling of income between 1970 and 1975. The Texas study area also showed gains in all sectors with the exception of agriculture, which declined in the South Plains Region.

In New Mexico, only agriculture registered a decline in earnings during the 1970s. However, unlike Texas, manufacturing showed only modest increases, while mining ranked as the fastest growing economic sector. Because of the state's

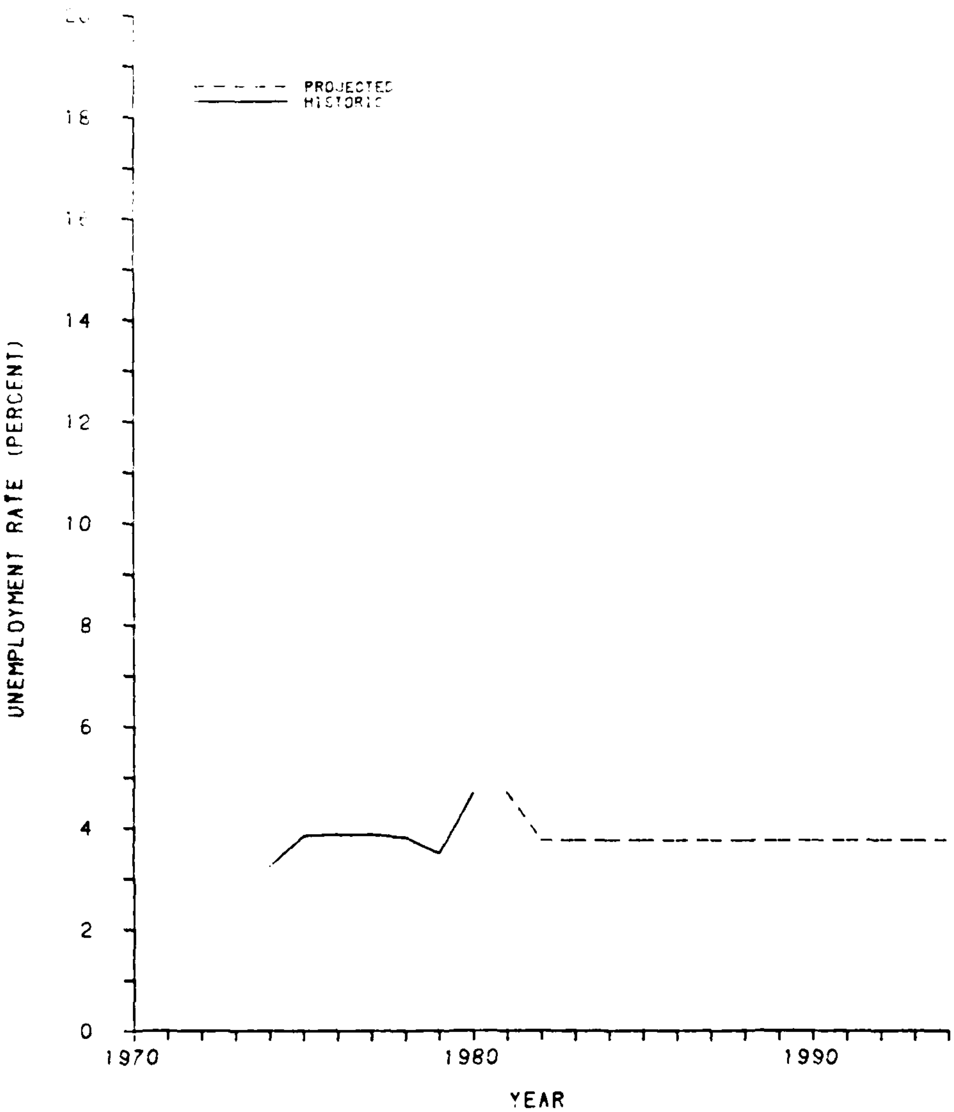


Figure 3.3.3.1-2. Historic and projected baseline rate of unemployment in Texas 17-county region.

Table 3.3.3.1-3. Total employment and percent share by major economic sectors for counties in New Mexico, 1977.

COUNTY	TOTAL EMPLOYMENT	PERCENT OF TOTAL STATE EMPLOYMENT	AGRICULTURE SHARE (PERCENT)	MINING SHARE (PERCENT)	CONSTRUCTION SHARE (PERCENT)	MANUFACTURE SHARE (PERCENT)	SERVICES SHARE (PERCENT)	GOVERNMENT SHARE (PERCENT)
Chaves	19,160	3.9	9.3	1.7[1]	4.2[1]	11.2	14.5	20.0
Curry	18,558	3.7	6.3	0.1	3.4	5.0	11.2	37.7
De Baca	991	0.2	28.9	0.0	3.9	2.0	(D)	27.3
Harding	664	0.1	47.3	(D)	(D)	8.7	4.5	22.0
Quay	4,900	1.0	18.8	0.2	3.6	3.4	14.9	23.2
Roosevelt	6,566	1.3	22.5	0.2	2.3	3.4	6.4	32.8
Union	2,212	0.4	31.0	(D)	1.9	0.9	11.1	22.9
New Mexico ROI	53,051	10.7	12.5	0.7[1]	3.5[1]	6.7	11.8	28.3
Total State	496,514	100.0	4.3	4.7	6.2	6.5	16.8	27.1
United States	97,848,874		4.2	0.8	4.0	20.1	17.4	18.2

3797-1

[1]Estimated

[2](D) = not shown to avoid disclosure of confidential information.

Source: BEA, April 1979.

Table 3.3.3.1-4. New Mexico employment growth by sector, study area counties, 1967 to 1977 (Page 1 of 2).

COUNTY	TOTAL			AGRICULTURE			MINING			CONSTRUCTION		
	1967	1977	Δ[1]	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ
Chaves	15,885	19,160	1.9	2,032	1,774	-1.3	438	334 '76	-3.0[4]	610	785 '76	2.8[5]
Curry	14,935	18,558	2.2	1,442	1,169	-2.1	(D)	16	(D)	125	628	4.0
De Baca	951	991	0.4	361	286	-2.3	(D)	0	(D)	(D)	39	(D)
Harding	702	664	-0.6	372	314	-1.7	0	(D)	(D)	15	(D)	(D)
Quay	4,793	4,900	0.2	1,165	922	-2.3	(D)	(L)[3]	(D)	146	176	1.9
Roosevelt	5,747	6,566	1.3	1,787	1,477	-1.9	51	12	-13.5	160	118	-1.3
Union	2,093	2,212	0.6	752	685	-0.9	(D)	(D)	(D)	21	43	6.0
Texas ROI	45,106	53,051	1.6	7,911	6,627	-1.8	489	352[6]	-3.2[5]	1,389	1,811	2.9[5]
Total State	358,436	496,514	3.3	24,907	21,127	-1.6	15,890	23,306	3.9	16,669	30,710	6.3
United States	82,506,400	97,848,874	1.7	4,625,000	4,152,874	-1.1	615,000	824,000	3.0	3,308,000	3,878,000	1.6

3798-1

Table 3.3.3.1-4. New Mexico employment growth by sector, study area counties, 1967 to 1977 (Page 2 of 2).

COUNTY	MANUFACTURING			SERVICES			GOVERNMENT		
	1967	1977	Δ	1967	1977	Δ	1967	1977	Δ
Chaves	1,030	2,154	7.7	2,503	2,781	1.1	3,171	3,834	1.9
Curry	572	925	4.9	1,444	2,078	3.7	5,719	6,990	2.0
De Baca	(D)	20	(D)	92	(D)	(D)	190	271	3.6
Harding	(D)	58	(D)	(D)	30	(D)	132	146	1.0
Quay	90	166	6.3	637	729	1.4	1,024	1,136	1.0
Roosevelt	224	221	-0.1	446	422	-0.5	1,261	2,156	5.5
Union	(D)	20	(D)	260	245	-0.6	391	506	2.6
Texas ROI	1,916	3,564	6.4[4]	5,382	6,285	1.6[4]	11,888	15,039	2.4
Total State	18,032	32,188	7.0	62,298	83,337	3.0	101,278	134,754	2.9
United States	14,504,000	19,696,000	0.1	12,675,000	17,030,000	3.0	13,924,400	17,795,000	2.5

3798-1

[1]Δ = Average annual growth rate.

[2](D) = Not shown to avoid disclosure of confidential information.

[3]L = Less than 10 wage and salary jobs.

[4] = Rate in doubt because of large number of data points withheld by disclosure rules.

[5] – = Undefined.

[6] = Estimate.

Source: BEA. April 1979.

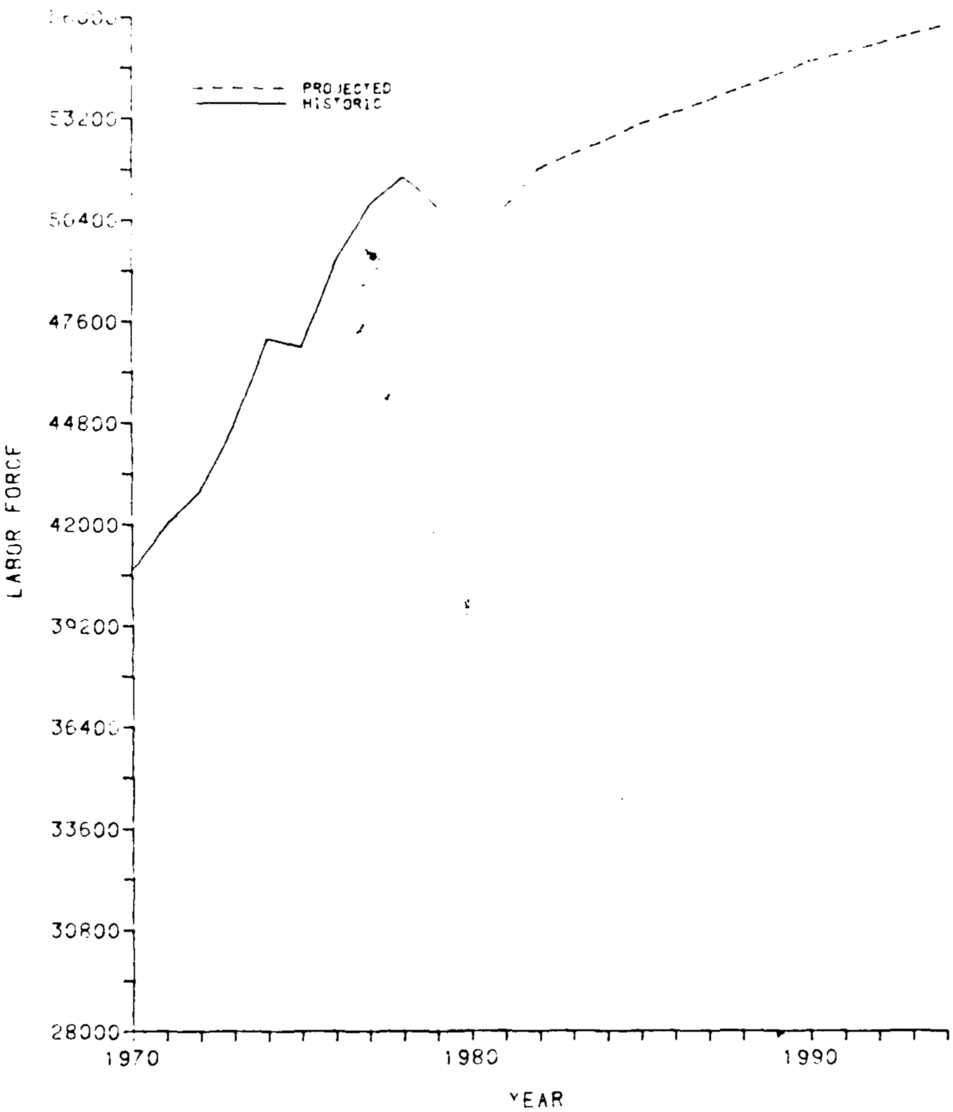


Figure 3.3.3.1-3. Historic and projected baseline labor force in New Mexico 7-county region.

energy resources, mining is expected to outpace all other activities in the early 1980s.

Both Texas and New Mexico have revenue structures that reflect a well-balance framework. Sales tax revenues constitute the principal source, accounting for one-fourth of the total in each state. Total revenues have grown at an average annual rate of 13.8 percent in Texas and 8.4 percent in New Mexico. The largest expenditure for both states was for education, which accounted for about half of the total. In both states social services were the second largest expenditure.

Texas

Total earnings have exhibited little growth over the 1968-1978 period in the Texas ROI. Table 3.3.3.2-1 highlights the Texas ROI earnings by major industrial sector relative to individual counties in the ROI, the state of Texas, and the U.S. These figures have been adjusted to 1978 dollars to account for inflation. It indicates that the region's 1978 total earnings of $2,916.3 million were only about four percent of the state total. Further, the region's annual earnings growth was less than one-half that for Texas as a whole over the 1968-1978 period. Disaggregating earnings by industry, however, shows that earnings growth in several sectors were relatively large-- manufacturing posted an 8.9 percent average annual growth rate, while construciton, mining, and services had average annual gains of 6.2, 6.9, and 4.5 percent, respectively. Government had a relatively small average annual growth rate of 0.7 percent per year while agricultural earnings decreased by $412.2 million between 1968 and 1978 at an average annual decline of 11.7 percent.

Table 3.3.3.2-2 highlights per capita income and earnings shares by major industry in the Texas ROI. The regions 1978 per capita income of $7,460 was roughly 95 percent that of both Texas and the national figure. By industrial source, manufacturing, services, and government contributed 14, 15, and 16 percent of 1978 earnings in the Texas ROI, respectively. The manufacturing sector earnings share for the region was well below that of the state and nation. Both services and government sectors kept pace with state earnings shares but were slightly lower than the national figures in those industries.

New Mexico

Total earnings in the New Mexico ROI have also exhibited little growth over the 1968-1978 period. Table 3.3.3.2-3 highlights the New Mexico ROI earnings by major industrial sector relative to individual counties in the ROI, the state of New Mexico, and the U.S. These figures are in 1978 dollars. It indicates that the region's 1978 earnings growth was less than one-half that for New Mexico over the 1968-1978 period. Disaggregating earnings by industry, however, shows that earnings growth in several industrial sectors were relatively large--manufacturing, construction, mining, and services experienced average annual growth rates of 6.4, 5.4, 3.8, and 3.2 percent, respectively. The government sector increased by 2.1 percent annually and had 1978 earnings totalling more than manufacturing, construction, mining, and services combined. Agricultural earnings dropped by 2.2 percent annually between 1968 and 1978 from $123.0 million to $98.6 million.

Table 3.3.3.2-4 highlights per capita income and earnings shares by major industry in the New Mexico ROI. The region's 1978 per capita income of $6,443 was

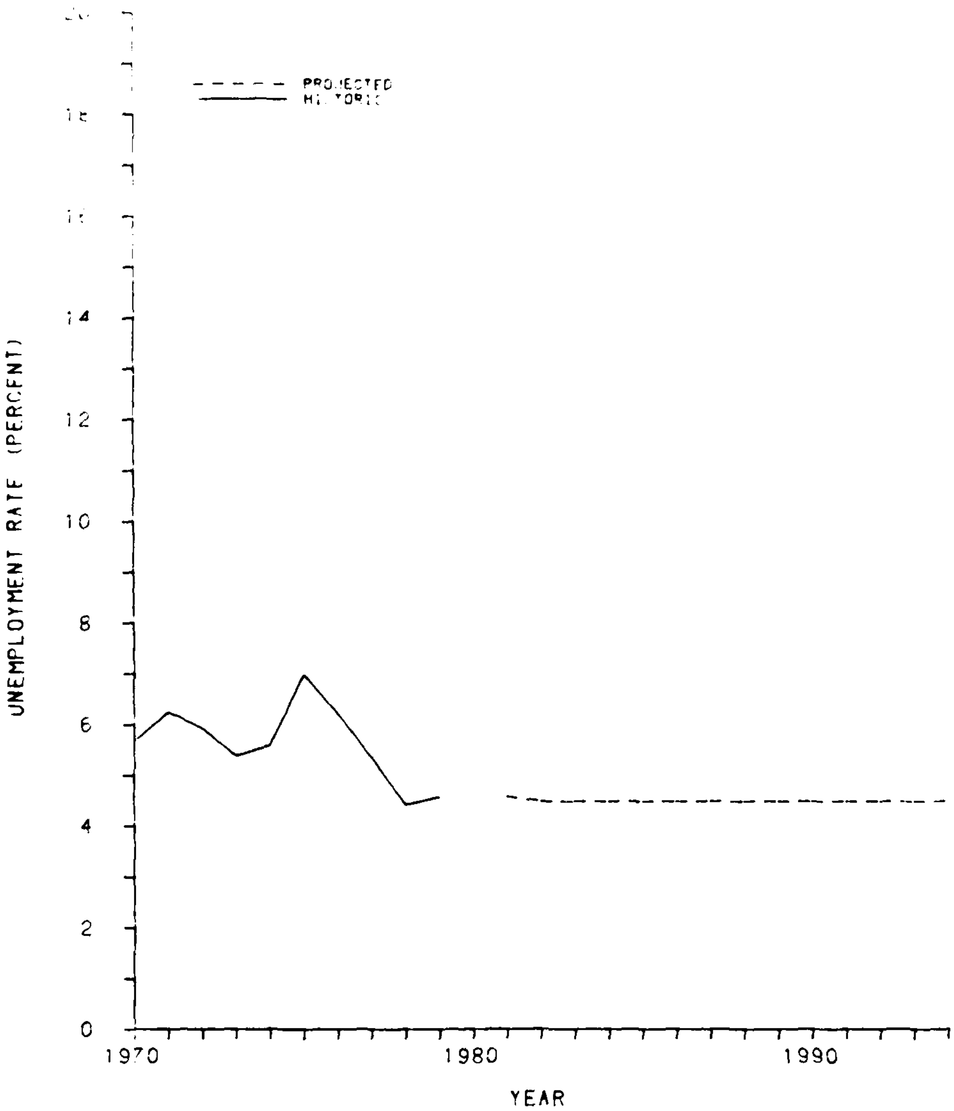


Figure 3.3.3.1-4. Historic and projected baseline rate of unemployment in New Mexico 7-county region.

Table 3.3.3.2-1. Earnings of economic sector, Texas counties, 1968-1978 (in thousands of 1978 dollars) (Page 1 of 2).

COUNTY	TOTAL EARNINGS			AGRICULTURE			MINING		
	1968	1978	%[1]	1968	1978	%	1968	1978	%
Bailey	46,133	35,236	-2.7	28,659	9,186	-10.8	(D)	(D)	(D)
Castro	67,020	55,679	-1.8	50,385	26,024	6.4	(L)[3]	(D)	(D)
Cochran	21,881	14,191	-4.2	13,290	2,618	-15.0	626	1,051	5.3
Dallam	37,425	37,233	-0.1	15,782	7,419	-7.2	(D)	(D)	(D)
Deaf Smith	108,874	124,229	1.3	63,791	40,051	-4.5	72,104	302	25.1
Hale	162,954	160,160	-0.2	67,988	22,898	-10.3	184	77,828	6.1
Hartley	14,411	7,439	-6.4	10,592	1,700	-16.7	(L)	0	0.0
Hockley	84,476	87,512	0.4	35,799	-1,210		13,161	33,167	9.4
Lamb	86,164	76,582	-1.2	51,347	21,818	-8.2	74,118	259	21.7
Lubbock	760,076	1,112,969	3.9	65,730	10,656	-16.6	1,727	6,326	13.9
Moore	83,044	86,374	0.4	18,579	-5,467		4,164	8512,276	9.3
Oldham	8,657	12,908	4.1	3,300	5,286	4.8	(D)	(D)	(D)
Parmer	86,481	42,752	-6.8	65,389	4,184	-24.0	(L)	0	0.0
Potter/Randal	716,753	1,004,891	3.4	18,291	3,956	-24.5	(D)	(D)	(D)
Sherman	32,327	4,846	-17.3	25,296	-6,642		257	2,182	23.8
Swisher	68,147	53,283	-2.4	44,558	24,067	-6.0	167	0	
Texas ROI	2,384,823	2,916,284	2.0	578,776	166,514	-11.7	20,961[5]	51,131[5]	10.0
Total State	50,632,048	79,094,829	4.6	2,493,921	1,320,190	-6.2	1,965,381	1,331,138	8.2
United States	1,039,655,600	1,318,750,000	2.4	33,188,000	33,188,000	0.1	10,528,125	20,552,000	6.9

3816-2

Table 3.3.3.2-1. Earnings of economic sector, Texas counties, 1968-1978 (in thousands of 1978 dollars) (Page 2 of 2).

COUNTY	CONSTRUCTION			MANUFACTURING			SERVICES			GOVERNMENT		
	1968	1978	Δ	1968	1978	Δ	1968	1978	Δ	1968	1978	Δ
Bailey	1,134	980	-1.4	849	4,356	17.8	3,105	4,173	3.0	3,302	3,378	[illegible]
Castro	849	1,671	7.0	1,629	4,169	9.9	3,199	4,256	2.9	3,334	5,199	4.5
Cochran	213	449	11.2	157	938	22.0	1,069	1,758	5.1	2,818	3,010	0.7
Dallam	1,603	855	-6.1	1,043	5,316	17.7	3,741	4,256	1.3	2,933	3,725	2.4
Deaf Smith	4,470	5,407	1.9	7,329	19,767	10.4	6,118	10,629	5.7	7,361	10,658	3.8
Hale	5,406	7,175	2.9	1,031	26,954	10.1	17,998	21,070	1.6	16,551	20,055	1.9
Hartley	920	341	-13.2[4]	144	(L)	-23.4[4]	218	1,331	19.9	1,050	929	-1.2
Hockley	2,415	4,251	5.8	1,226	2,537	7.5	7,258	8,613	1.7	9,238	13,884	4.2
Lamb	1,444	2,079	4.1[4]	1,524	10,198	20.9	7,335	8,244	1.2	6,060	7,810	2.6
Lubbock	43,952	77,285	5.8	76,528	164,481	8.0	119,109	189,966	4.8	159,724	220,244	3.3
Moore	7,489	7,417	-0.1	21,578	31,140	3.7	5,310	9,333	6.5[4]	9,091	8,749	-0.4
Oldham	1,033	767	-5.8[4]	(L)	(L)	0.0[6]	294	2,050	21.4	1,086	1,484	3.2
Parmer	960	2,292	9.1	3,589	12,231	13.0	3,480	5,313	4.3	4,200	4,849	1.4
Potran	39,501	93,845	9.0	59,919	130,166	8.1	102,053	163,666	4.8	188,184	140,225	-2.9
Sherman	624	1,104	5.9	141	158	1.1	705	1,249	5.9	1,802	1,863	0.3
Swisher	848	1,115	2.8	786	2,432	12.0	3,409	5,164	4.2	4,881	5,525	1.2
Texas ROI	113,554	207,148	6.2	177,445	414,843	8.9	284,401	411,678	4.5	421,618	151,587	0.7
Total State	3,318,426	6,656,905	7.2	10,601,873	15,748,144	4.0	7,048,781	12,276,159	5.7	9,423,238	12,251,386	2.7
United States	62,388,750	79,872,000	2.5	303,099,380	345,771,000	1.3	153,226,880	221,951,000	3.8	174,725,630	216,896,000	2.2

3816-2

[1]Δ = Average annual growth rate.

[2](D) = Not shown to avoid disclosure of confidential information.

[3](L) = Less than 10 wage and salary jobs.

[4]Rate in doubt because of large number of data points withheld by disclosure rules.

[5]—— = Undefined.

[6] = Estimate.

Table 3.3.3.2-2. Per capita income and earnings shares by economic sector, Texas counties, 1978.

COUNTY	1978 PER CAPITA INCOME	TOTAL 1978 EARNINGS (000's of $)	PERCENT OF TOTAL STATE EARNINGS	AGRICULTURE SHARE (PERCENT)	MINING SHARE (PERCENT)	CONSTRUCTION SHARE (PERCENT)	MANUFACTURE SHARE (PERCENT)	SERVICES SHARE (PERCENT)	GOVERNMENT SHARE (PERCENT)
Bailey	6,870	35,236	0.04	26.1	(D)	2.8	12.4	11.8	10.7
Castro	6,359	55,679	0.07	46.7	(D)	3.0	7.5	7.6	9.3
Cochran	4,907	14,191	0.02	18.4	7.4	3.2	6.6	12.4	21.2
Dallam	7,957	37,233	0.05	19.9	(D)	2.3	14.3	11.4	10.0
Deaf Smith	8,054	124,229	0.16	32.2	0.3	4.4	15.9	8.6	8.6
Hale	6,683	160,160	0.20	14.3	0.5[1]	4.5	16.8	13.2	12.5
Hartley	5,104	7,439	0.01	22.9	0.0	4.6	0.1[1]	17.9	12.5
Hockley	6,070	87,512	0.11	-1.4	37.4	4.8	2.9	9.7	15.6
Lamb	6,822	76,582	0.10	28.5	0.3	2.8[1]	13.3	10.8	10.2
Lubbock	7,260	1,112,969	1.41	1.0	0.6	6.9	14.8	17.1	19.8
Moore	6,944	86,374	0.11	-6.0	11.8[1]	8.1	33.9	11.5[1]	9.5
Oldham	6,403	12,908	0.02	41.0	(D)	5.9	0.1[1]	15.9	11.5
Parmer	5,767	42,752	0.05	9.8	0.0	5.4	28.6	12.4	11.3
Potter/Randall	8,472	1,004,891	1.27	0.4	(D)	9.3	13.0	16.3	14.0
Sherman	3,214	4,846	0.01	-57.8	19.0	9.6	1.4	9.8	14.6
Swisher	7,702	53,283	0.07	45.2	0.0	2.1	4.6	9.7	10.4
Texas ROI	7,460	2,916,284	3.69	5.7	1.9[1]	7.1[1]	14.2	15.1[1]	15.5
Total State	7,746	79,094,829	100.00	1.7	5.5	8.4	19.9	15.5	15.5
United States	7,840	1,318,750,000		4.4	1.6	6.1	26.2	16.8	16.4

3800-2

[1]Estimated.

[2](D) = not shown to avoid disclosure of confidential information.

Source: BEA, July 1980.

Table 3.3.3.2-3. Earnings by economic sector, New Mexico counties, 1968-1978 (in thousands of 1978 dollars). (Page 1 cf 2)

COUNTY	TOTAL EARNINGS			AGRICULTURE			MINING		
	1968	1978	Δ^1	1968	1978	Δ^1	1968	1978	Δ^1
Chaves	161,706	208,420	2.6	34,588	25,340	-3.1	6,803	9,803	3.3
Curry	176,884	208,420	1.6	30,538	20,328	-4.0	288	346	2.1[4]
De Baca	6,626	10,100	4.3	2,244	4,243	6.6	(D)	(D)	(D)
Harding	4,974	4,655	-0.7	2,370	1,050	-7.8	(L)[3]	(D)	(D)
Quay	38,136	46,458	2.0	10,309	10,165	-0.1	175	348	12.1[4]
Roosevelt	62,820	67,935	0.8	28,491	22,083	-2.5	452	978	8.0
Union	25,279	30,275	1.8	14,421	15,427	0.7	(D)	(D)	(D)
New Mexico ROI	476,425	575,856	1.9	122,961	98,636	-2.2	7,648[6]	11,129	3.8[4]
Total State	4,027,776	6,166,041	4.4	266,644	266,644	-1.0	259,376	541,278	7.7
United States	1,039,655,600	1,318,750,000	2.4	33,005,625	33,188,000	0.1	10,528,125	20,552,000	6.9

3817-2

Table 3.3.3.2-3. Earnings by economic sector, New Mexico counties, 1968-1978 (in thousands of 1978 dollars). (Page 2 of 2)

COUNTY	CONSTRUCTION			MANUFACTURING		
	1968	1978	Δ	1968	1978	Δ
Chaves	8,254	13,650	5.2	11,846	25,124	7.8
Curry	6,504	9,597	4.0	7,905	12,105	4.4
De Baca	366	675	6.3	105	153	5.5[4]
Harding	260	101	-8.2[4]	491	976	10.3[4]
Quay	1,292	4,015	12.0	724	1,390	6.7
Roosevelt	1,742	1,888	0.8	1,916	2,530	2.8
Union	696	2,346	12.9	205	432	9.8[4]
New Mexico ROI	19,094[6]	32,272	5.4	23,016[6]	42,710	6.4
Total State	264,064	517,492	7.0	237,330	430,710	6.1
United States	62,388,750	79,872,000	2.5	303,099,380	345,771,000	1.3

3817-2

COUNTY	SERVICES			GOVERNMENT		
	1968	1978	Δ	1968	1978	Δ
Chaves	21,660	29,443	3.1	26,754	38,703	3.8
Curry	14,044	22,317	4.7	71,128	78,939	1.0
De Baca	699	751	0.7	1,558	1,897	2.0
Harding	117	132	1.3[4]	1,144	1,475	2.6
Quay	4,142	4,599	1.1	9,032	10,316	1.3
Roosevelt	3,769	4,492	1.9	13,886	21,474	4.5
Union	1,862	1,905	0.2	3,919	4,446	1.3
New Mexico ROI	46,290[6]	63,639	3.2	127,421	157,250	2.1
Total State	687,840	1,012,124	3.9	1,242,111	1,652,096	2.9
United States	153,226,880	221,951,000	3.8	174,725,630	216,896,000	2.2

3817-2

[1]Δ = Average annual growth rate.

[2](D) = Not shown to avoid disclosure of confidential information.

[3](L) = Less than 10 wage and salary jobs.

[4]Rate in doubt because of large number of data points withheld by disclosure rules.

[5]— = Undefined.

[6]Estimate.

Source: BEA, July 1980.

Table 3.3.3.2-4. Per capita income and earnings shares by economic sector, New Mexico counties, 1978.

COUNTY	1978 PER CAPITA INCOME	TOTAL 1978 EARNINGS (000's of $)	PERCENT OF TOTAL STATE EARNINGS	AGRICULTURE SHARE (PERCENT)	MINING SHARE (PERCENT)	CONSTRUCTION SHARE (PERCENT)	MANUFACTURE SHARE (PERCENT)	SERVICES SHARE (PERCENT)	GOVERNMENT SHARE (PERCENT)
Chaves	6,238	208,420	3.4	12.2	4.5	6.5	12.1	14.1	18.6
Curry	6,767	208,013	3.4	9.8	0.2	4.6	5.8	10.7	37.9
De Baca	5,708	10,100	0.2	42.0	(D)	6.7	1.5	7.4	18.8
Harding	5,529	4,655	0.1	22.6	(D)	2.2	21.0	28.4	31.7
Quay	6,224	46,458	0.8	21.9	0.7	8.6	3.0	9.9	22.2
Roosevelt	6,107	67,935	1.1	32.5	1.4	2.8	3.7	6.6	31.6
Union	8,010	30,275	0.5	51.0	(D)	7.7	1.4	6.3	14.7
Texas ROI	6,443	575,856	9.3	17.1	1.9	5.6	7.4	11.1	27.3
Total State	6,599	6,166,041	100.0	6.8	8.8	8.4	7.0	16.4	26.8
United States	7,840	1,318,750,000		4.4	1.6	6.1	26.2	16.8	16

[1]Estimated.

[2](D) = not shown to avoid disclosure of confidential information.

Source: BEA, July 1980.

3801-1

98 percent that of New Mexico's, but only 82 percent of U.S. per capita income. By industrial source, government, agriculture, and services contributed 27, 17, and 11 percent of 1978 earnings in the New Mexico ROI, respectively. The share of total employment in manufacturing for the region and state was only seven percent, well below one-third that of the national earnings share.

Public Finance (3.3.3.3)

Sales tax revenues constitute the principal revenue source in both states. Total revenues have grown at average annual rates of 8.6 percent in Texas over the 1977-1979 period, and 8.4 percent in New Mexico over the 1975-1977 period (Annual Report of the Comptroller, 1979 (Texas); New Mexico Statistical Abstract, 1978).

Population and Communities (3.3.3.4)

Table 3.3.3.4-1, shows population growth rates of 18 and 13 percent for Texas and New Mexico, respectively, for the decade between 1965 and 1975. Both have been among the 12 fastest growing states in the nation since 1970, primarily as a result of in-migration.

Texas experienced a population growth of 10.9 percent between 1970 and 1975, or 2 percent annually, well above the national average, and attributable to the large amount of in-migration. In contrast to the national trend, population growth in Texas, until recently, has occurred primarily in cities and metropolitan areas, rather than in small towns or rural areas. The state's population is projected to increase from an estimated 13.4 million in 1980 to 18.3 million by the year 2000.

In contrast to Texas, New Mexico experienced net out-migration during the 1960s, resulting in a growth rate of less than 1 percent annually. This trend has been reversed since 1970 and net in-migration, combined with the highest birth rate in the western United States, is expected to contribute to a high rate of growth in the future. Net in-migration to the Albuquerque metropolitan area has counter-balanced out-migration from rural areas in the past, although recent data suggest that some rural counties are now experiencing net in-migration. New Mexico's total population is projected to exceed 1.5 million by 1990.

Transportation (3.3.3.5)

Roads (3.3.3.5.1)

The principal routes are U.S. 82 and 180 (east-west) and U.S. 87, 285, and 385 and Interstate 22 (north-south). Figure 3.3.3.5-1 shows the principal federal and state highways. Also shown is the annual average daily traffic for 1975. Numerous county roads cross the area, connecting the cities and communities. Those with populations over 1,000 are circled in Figure 3.3.3.5-1.

There are few topographic features that influence alignment or grades. Most of the roadways are two-lane facilities, but the interstate route and some of the federal and state routes are four lanes and all are adequate. Roads are generally of good quality, with few capacity restrictions.

Load-carrying limits in New Mexico are the same for interstates, U.S. highways, and state routes. These limits are 24,000 lb for a single-axle truck, and

Table 3.3.3.4-1. Population and employment in Texas/New Mexico by year 1965-1975.

YEAR	TEXAS		NEW MEXICO	
	EMPLOYMENT	POPULATION	EMPLOYMENT	POPULATION
1965		10,378,000		1,012,000
1966		10,492,000		1,007,000
1967	4,419,612	10,599,000	358,436	1,000,000
1968	4,566,630	10,819,000	362,128	994,000
1969	4,748,531	11,045,000	374,439	1,011,000
1970	4,777,239	11,236,000	376,007	1,023,000
1971	4,831,192	11,416,000	393,254	1,053,000
1972	4,963,583	11,603,400	412,503	1,076,300
1973	5,215,356	11,828,438	428,641	1,099,253
1974	5,403,836	12,017,132	440,327	1,119,049
1975	5,491,228	12,236,233	445,012	1,146,744

2163-1

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

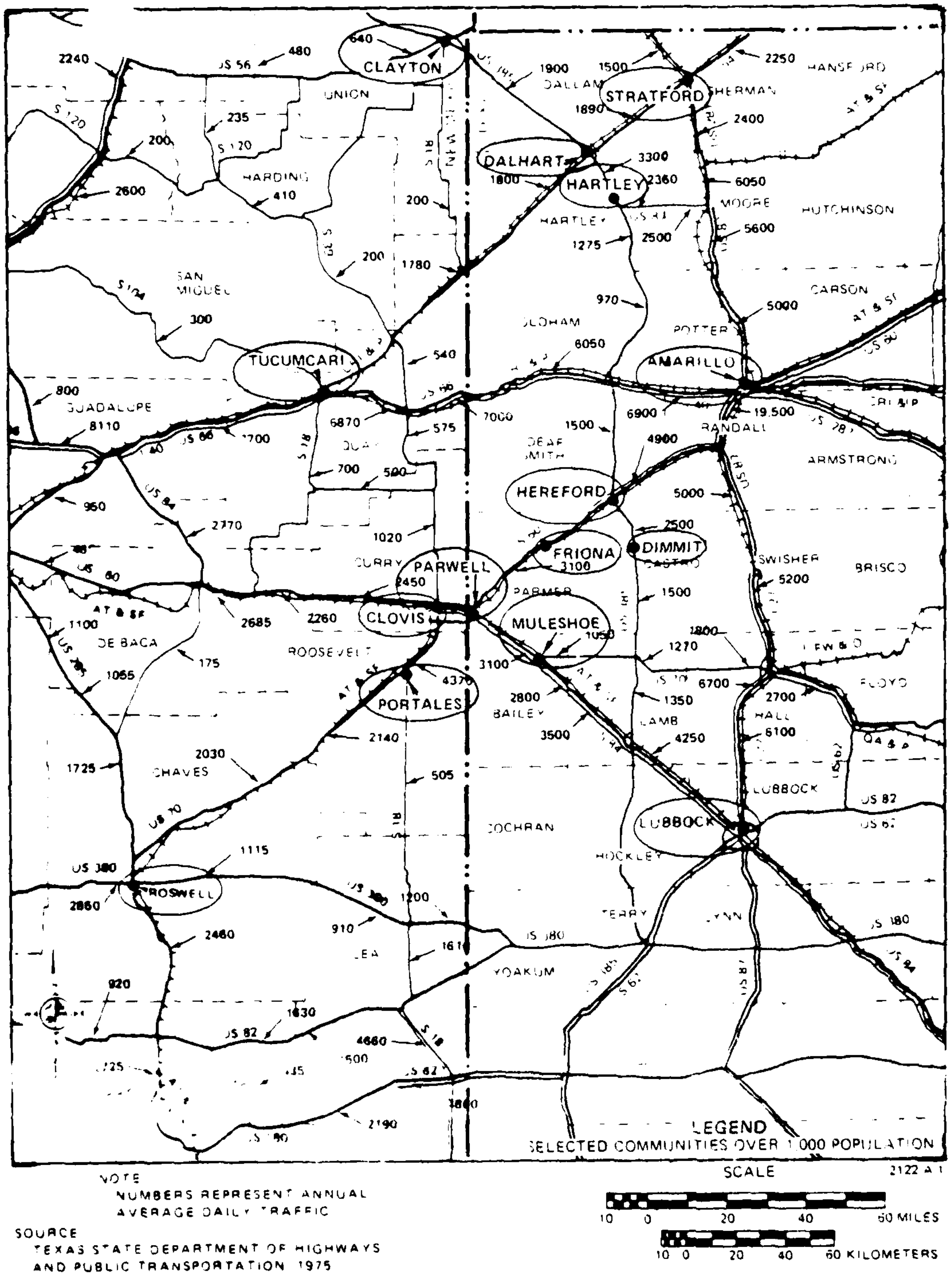


Figure 3.3.3.5-1. Roads sections and communities in the Texas/ New Mexico study area.

42,000 lb for a tandem. Weights for multiple-axle vehicles are based on vehicle size and axle spacing. Vehicles with more than six axles are discouraged because of deteriorated road conditions and potential road damage. Width, height, and length legal limits are 10 ft, 13 ft 6 in., and 65 ft, respectively.

In Texas, load-carrying limits vary with the type of road and there is regional variation depending on road conditions. In general, on U.S. highways and interstates the weight for a single axle is 13,000 lb. For each additional axle, the maximum weight/axle with a permit is 22,500 lb. On state routes, the maximum with a permit is 18,500 lb per axle. Limitations on width also depend on the route. The interstate limit is 14 ft, and right-hand lane travel only is permitted, no passing. Widths up to 28 ft can be permitted on state roads and U.S. highways, but clearance must be received from all districts, and escorts are required in front and behind the vehicle.

Railroads (3.3.3.5.2)

The Chicago, Rock Island, and Pacific Railroad runs west to east via Vaughn, New Mexico, and Amarillo, Texas. From Tucumcari, New Mexico, another branch runs northeasterly through Dalhart to Oklahoma. At Dalhart a branch runs easterly though Etter and Morse Junction.

The Atchison, Topeka, and Santa Fe Railroad services Vaughn, Clovis, and Dalhart, Amarillo, and other cities.

The Colorado and Southern Railroad runs southeasterly through the northeast tip of New Mexico and into Texas to Dalhart, where it intersects the Chicago, Rock Island, and Pacific Ralroad. It then continues southeasterly to Amarillo.

Air Traffic (3.3.3.5.3)

Airline service is provided by the commercial airports at Clovis and Roswell, New Mexico, and Lubbock, and Amarillo, Texas.

Energy (3.3.3.6)

Fuel Supply

Within the Texas/New Mexico region, there are numerous natural gas, crude oil, and product oil pipelines. A map of the existing and proposed pipelines produced from information supplied by the energy companies and the federal agencies is presented in Figure 3.3.3.6-1. Projected fuel consumptions for the area are presented in Table 3.3.3.6-1.

Electric Power Supply

The Texas/New Mexico study area is serviced by Region 22 of the Southwest Power Pool (SWPP). Projected peak demands without M-X and resources are presented for winter and summer conditions in Figures 3.3.3.6-2 and 3.3.3.6-3, respectively. At present the majority of electric power is produced by burning natural gas. Much of the projected increase in capacity will be generated with coal-fired facilities.

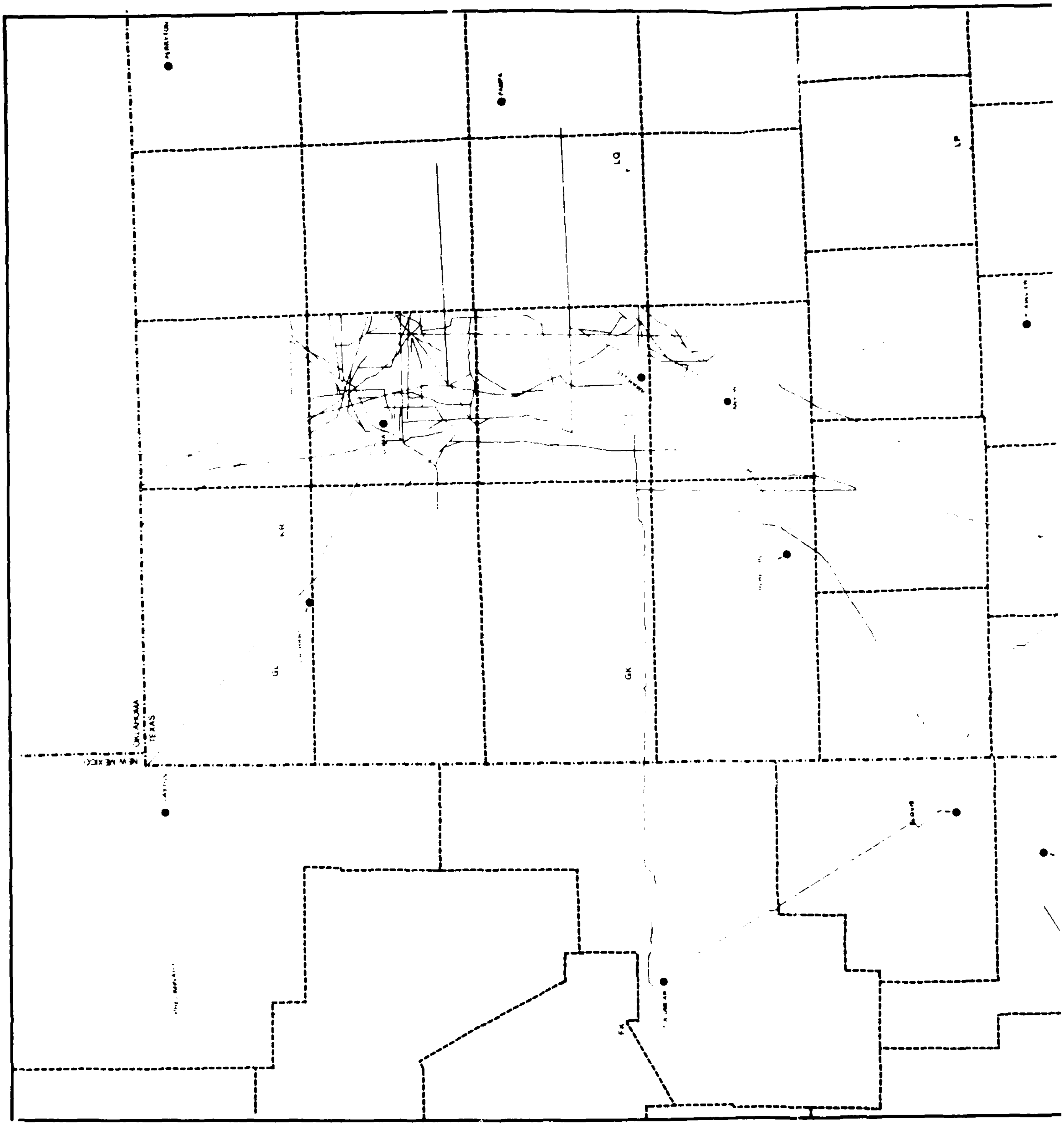


Figure 3.3.3.6-1.

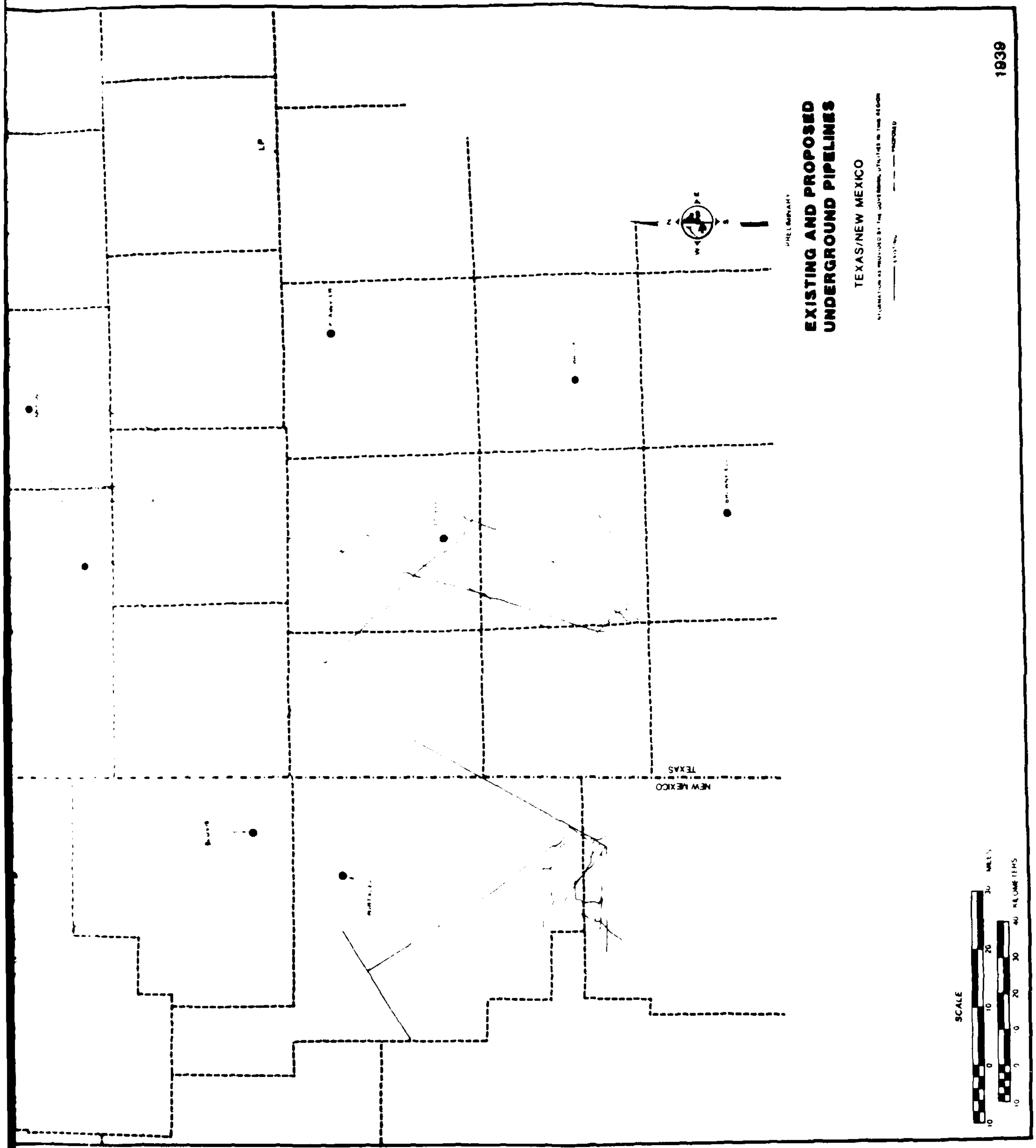


Figure 3.3.3.6-1. Existing and proposed underground pipelines in Texas/New Mexico region.

2

Table 3.3.3.6-1. Fuel consumption projections.

FUEL	TEXAS			NEW MEXICO		
	1978	1985	1990	1978	1985	1990
Total Petroleum (10^3 BBLS)	448,520	398,150	403,030	42,910	34,970	35,400
Natural Gas (Dry) (10^6 ft^3)	4,211,430	4,000,860	4,169,320	213,700	203.010	211,560
Total Fuel Oil (Dist.) (10^3 BBLS)	8,170	65,420	69,900	9,630	7,760	8,290
Diesel Fuel (Dist.) (10^3 BBLS)	25,230	20,330	21,730	3,570	2,880	3,070
Heating Fuel (Dist.) (10^3 BBLS)	10,080	8,120	8,680	520	420	450
Gasoline (10^3 BBLS)	201,990	169,270	160,990	18,920	18,920	15,080
Jet Fuel (10^3 BBLS)	28,540	28,540	31,130	2,790	2,790	3,050

3310

1 Barrel = 42 Gallons

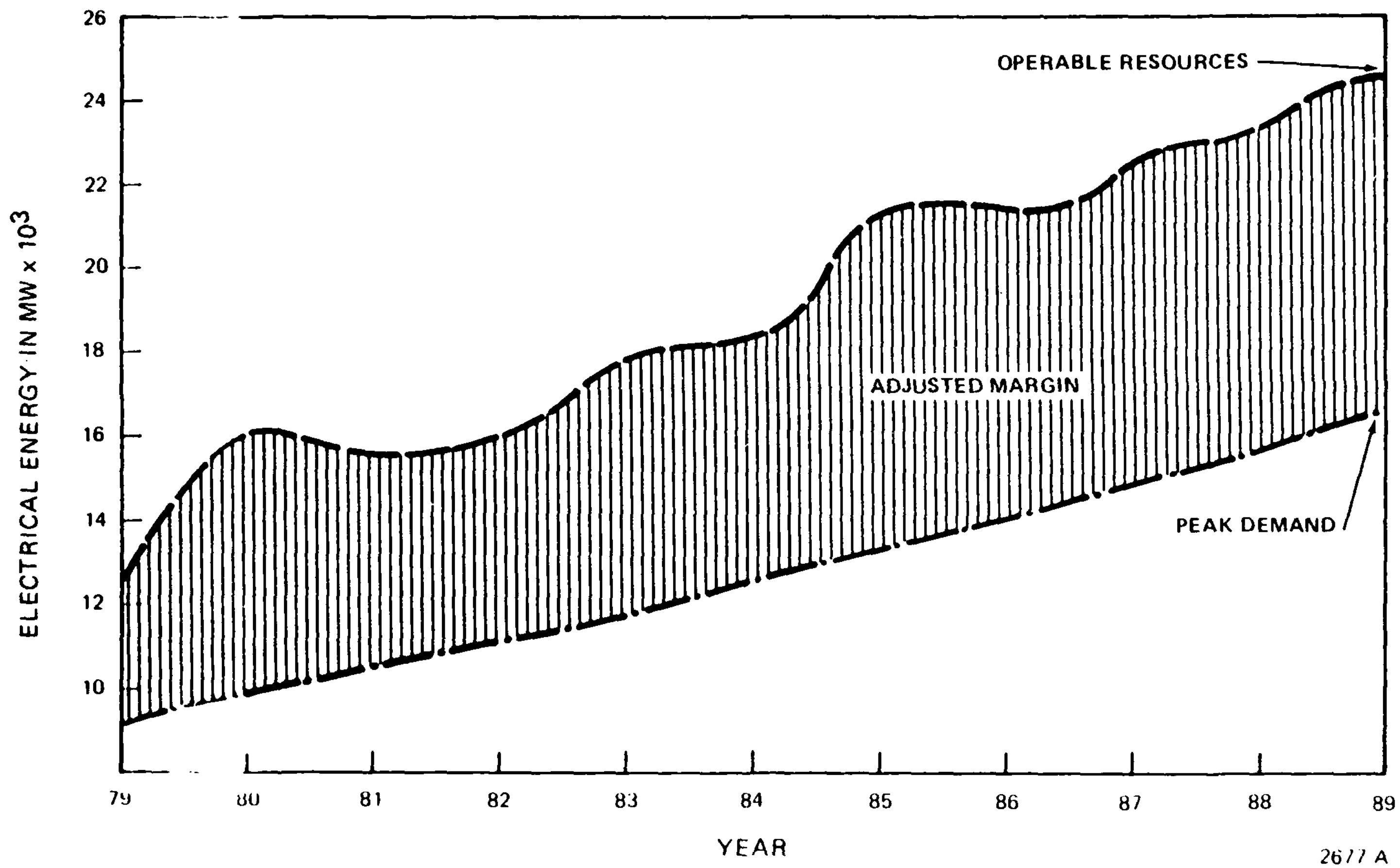


Figure 3.3.3.6-2. Southwest Power Pool (SWPP), Region 22, peak demands and resources projected (winter conditions, Texas/New Mexico).

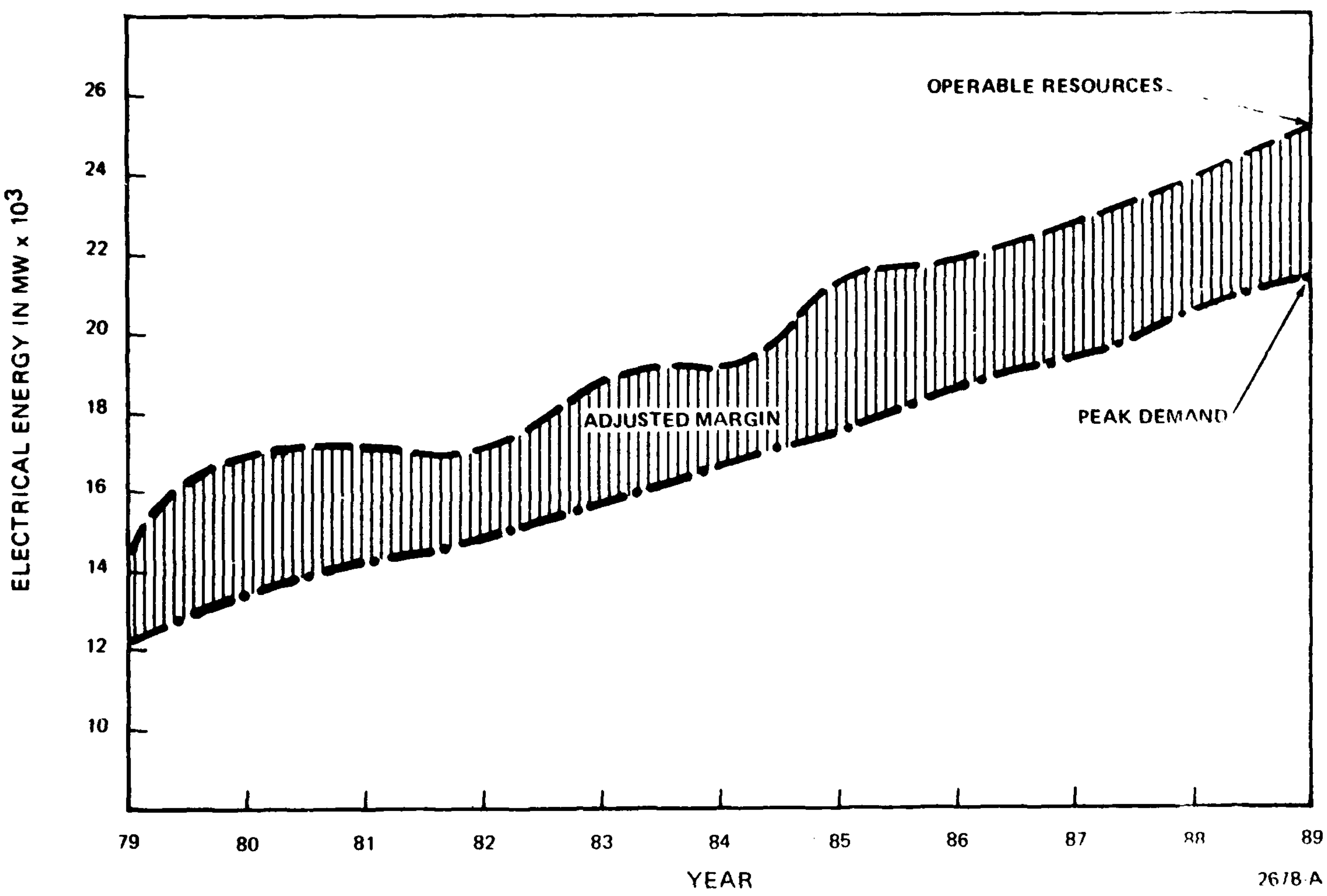


Figure 3.3.3.6-3. Southwest Power Pool (SWPP), Region 22, peak demands and resources projected (summer conditions, Texas/New Mexico).

A map of the existing and proposed transmission lines is shown in Figure 3.3.3.6-4.

Land Ownership (3.3.3.7)

Federal Land, Texas/New Mexico

The location of federal land is shown in Figure 3.3.3.7-1. Table 3.3.3.7-1 shows the amount of federal and BLM-administered land. The National Park Service administers lands of historic, cultural, or scenic and recreational values. The major National Park Service holding is the Lake Meredith National Recreational Area. The Kiowa and Rita Blanca National Grasslands are administered by the U.S. Forest Service. The Buffalo Lake National Wildlife Reserve is another large federal land parcel managed by the U.S. Fish and Wildlife Service.

Private Land, Texas/New Mexico

Most of the land in the study area is privately owned. Chaves County is the only New Mexico county with less than 50 percent privately owned land. Most of BLM-administered land is located in the western part of the county. The other counties are about 72 percent privately owned. Texas counties are almost totally privately owned. Figure 3.3.3.7-2 shows the location of private land. Table 3.3.3.7-1 shows the number of acres of private land and the percentage of the total land in each county.

State Land, Texas/New Mexico

In Texas the only state lands are those that have been acquired from private owners. In New Mexico, lands were conveyed to the state by the federal government as a condition of statehood. Figure 3.3.3.7-3 shows that at least two sections in every township are owned by the state. Table 3.3.3.7-1 shows the amount and percentage of state land by county.

Land Use (3.3.3.8)

Agricultural land uses are croplands and grazing lands. Many of the cropland areas have irrigation systems that have increased productivity. Table 3.3.3.8-1 indicates the number of farms, total farmland acreage, and the percentage of total farmland. Farming trends from 1950-1974 are shown in Table 3.3.3.8-2. Since 1950, harvested areas in New Mexico have fallen 50 percent, and in Texas 30 percent, due to water costs and other reasons.

Cropland productivity in the High Plains region of Texas is high. This productivity zone, attributed to the Ogallala aquifer, extends west into portions of eastern New Mexico. Approximately 28 percent of area is irrigated cropland. About 60 percent is rangeland and the remainder nonirrigated farmland.

Table 3.3.3.8-3 shows the amount of cropland, harvested cropland, and pasture land for the study area counties. As noted in the table, the proportion of the state's total cropland is significantly higher in New Mexico (61.2 percent) than in Texas (13.4 percent). Table 3.3.3.8-4 provides data on the value of the agricultural products sold in the study area counties.

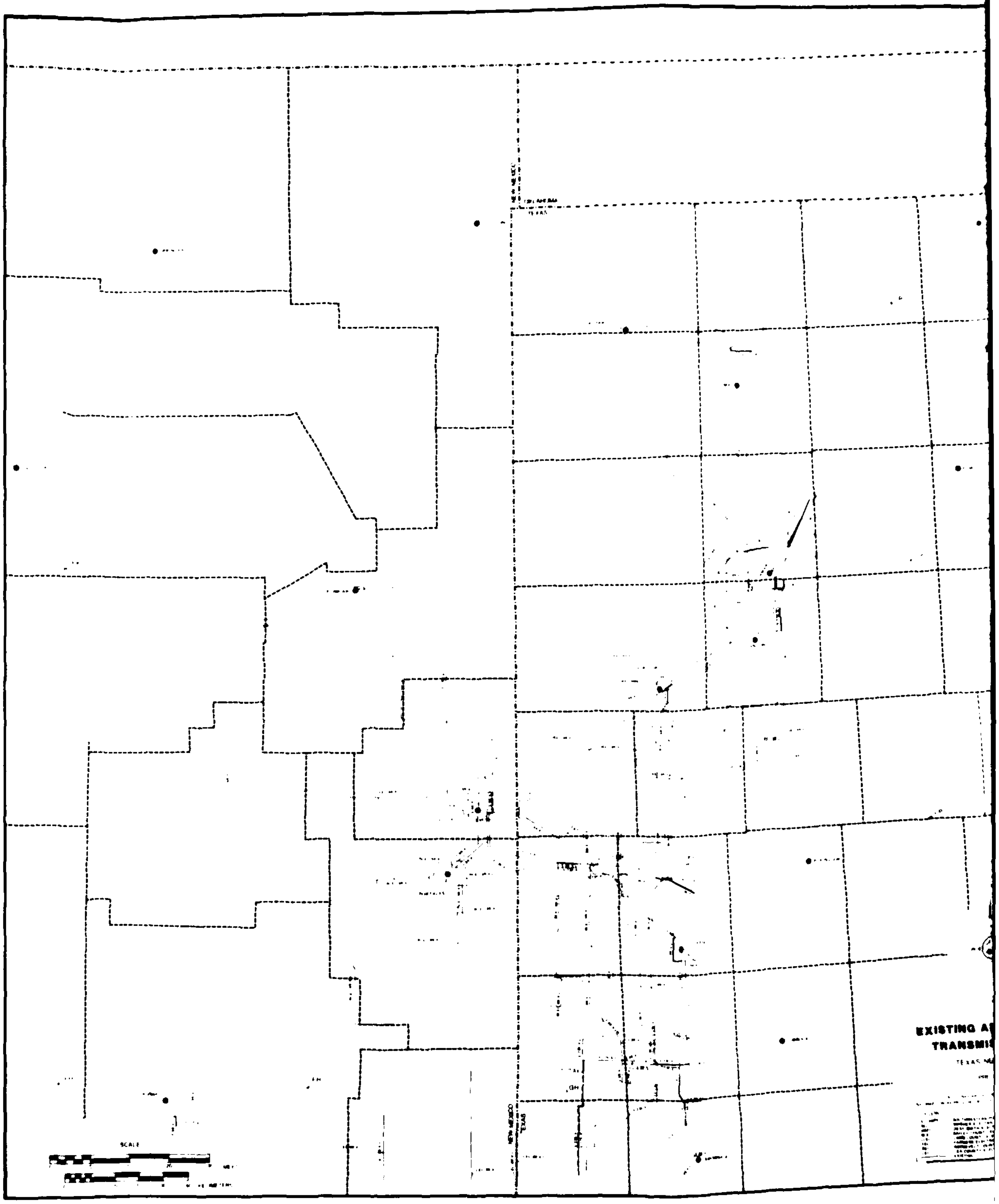
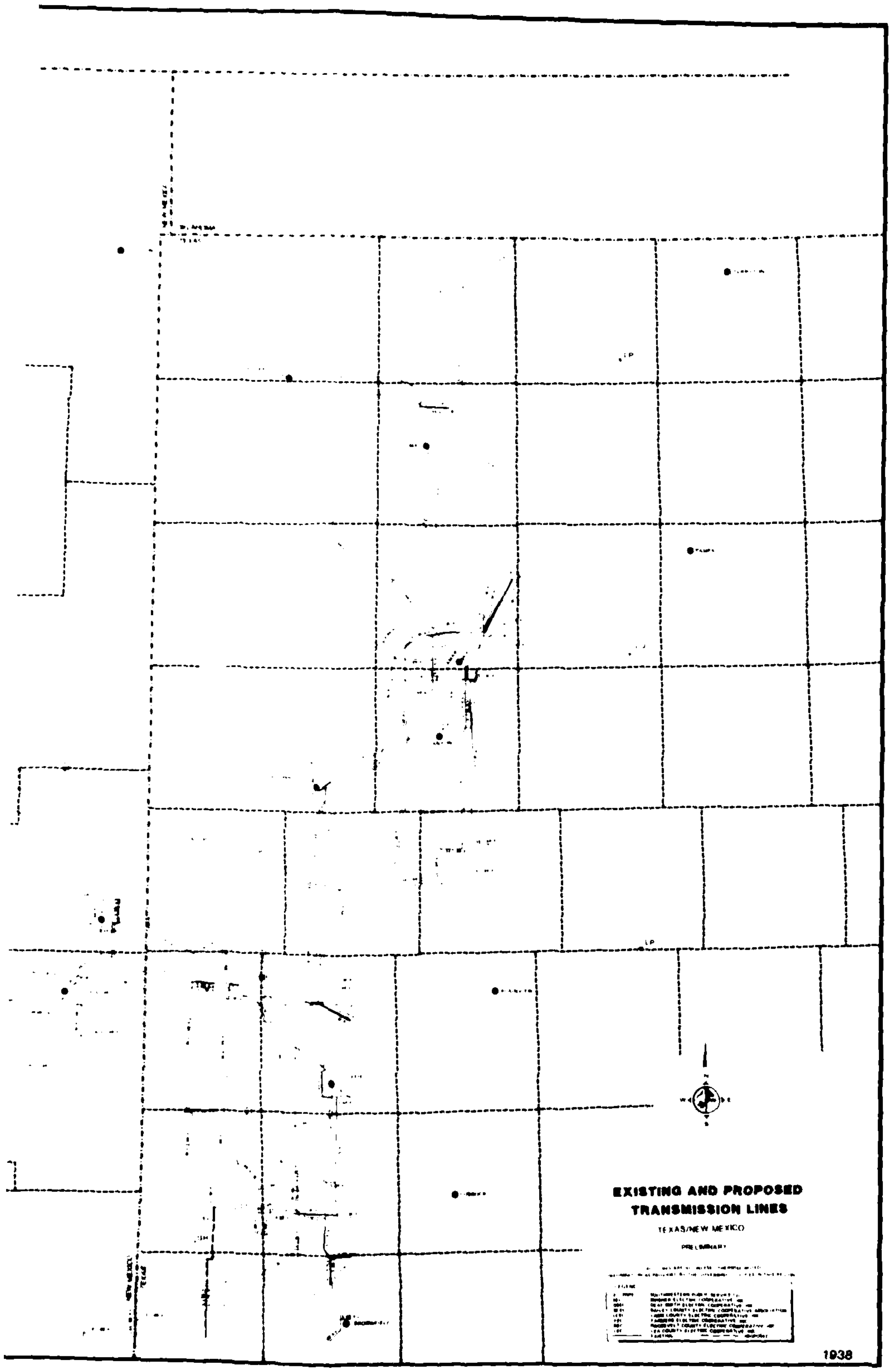


Figure 3.3.3.6-4. Existing and proposed transmission lines in Texas/New Mex



nd proposed transmission lines in Texas/New Mexico region.

Table 3.3.3.7-1. State, private and BLM-administered lands in the Texas/New Mexico study area counties, in thousands of acres.

STATE/ COUNTY	TOTAL AREA	FEDERAL LANDS	PERCENT OF TOTAL	BLM-ADMINISTERED LAND	PERCENT OF TOTAL	STATE LANDS	PERCENT OF TOTAL	PRIVATELY OWNED LANDS	PERCENT OF TOTAL
Texas									
Bailey	536	5.8	1.1	—	—	—	—	530	98.9
Castro	563	—	—	—	—	—	—	563	100.0
Cochran	501	—	—	—	—	—	—	501	100.0
Dallam	956	77.2	8.1	—	—	—	—	879	91.9
Deaf Smith	736	—	—	—	—	—	—	736	100.0
Hale	626	—	—	—	—	—	—	626	100.0
Hartley	956	—	—	—	—	—	—	956	100.0
Lamb	654	—	—	—	—	—	—	654	100.0
Moore	582	—	—	—	—	—	—	575	98.8
Oldham	946	—	—	—	—	—	—	946	100.0
Parmer	550	—	—	—	—	—	—	550	100.0
Randall	585	7.2	1.4	—	—	—	—	567	96.9
Swisher	573	0.6	0.1	—	—	—	—	572	99.8
New Mexico									
Chaves	3,901	1,266.0	32.5	1,195.9	30.7	703.6	18.0	1,932	49.5
Curry	899	3.9	8.4	0.4	0.4	60.7	6.8	834	92.8
De Baca	1,514	90.8	6.0	81.5	5.4	243.6	16.1	1,180	77.9
Harding	1,368	70.5	5.2	7.7	0.6	345.0	25.2	953	69.7
Quay	1,845	14.5	0.8	7.6	0.4	237.7	12.9	1,593	86.3
Roosevelt	1,572	38.5	2.4	16.4	1.0	211.1	13.4	1,323	84.2
Union	2,443	58.7	2.4	0.5	0.02	441.9	18.1	1,942	79.5
Study Area Totals	22,306	1,641.7	7.4	1,302.3	5.8	2,243.6	10.1	19,412	92.5

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NOTE: Percent totals may not equal 100% due to rounding.

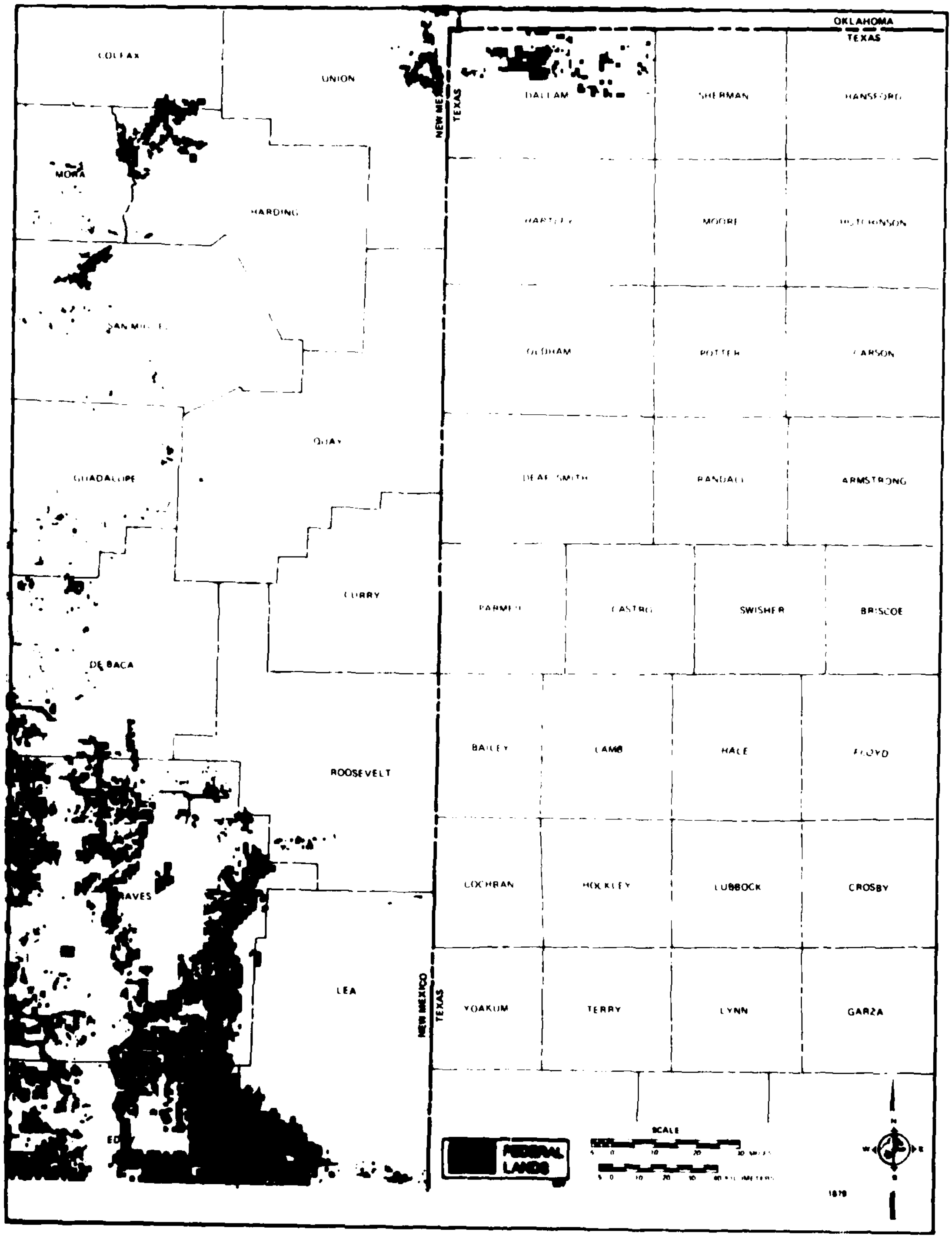

Figure 3.3.3.7-1. Federal lands in the Texas/New Mexico study area.


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DALLAM
SANTA FE
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DEAF SMI
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LINCOLN
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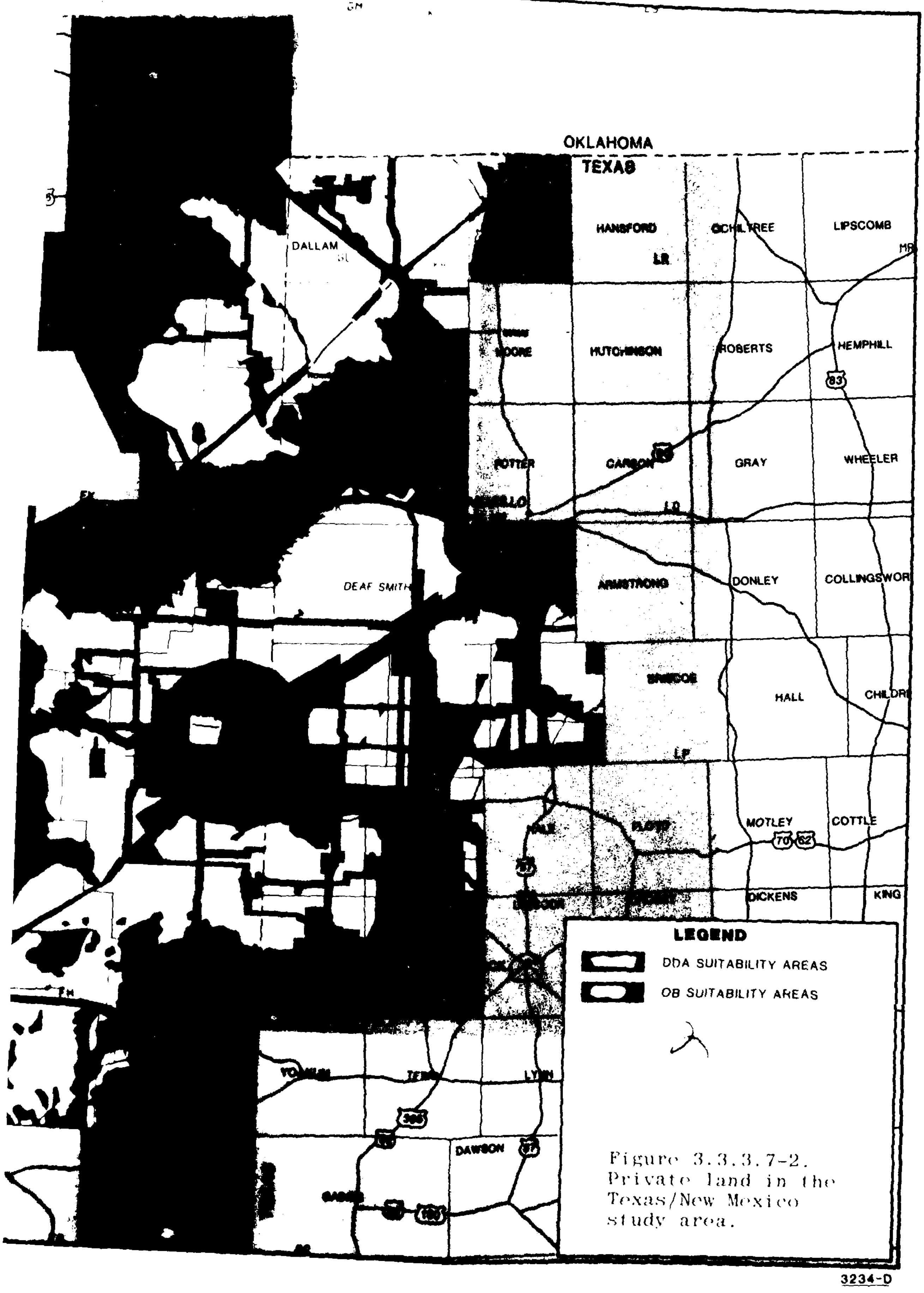

Figure 3.3.3.7-2. Private land in the Texas/New Mexico study area.

3234-D

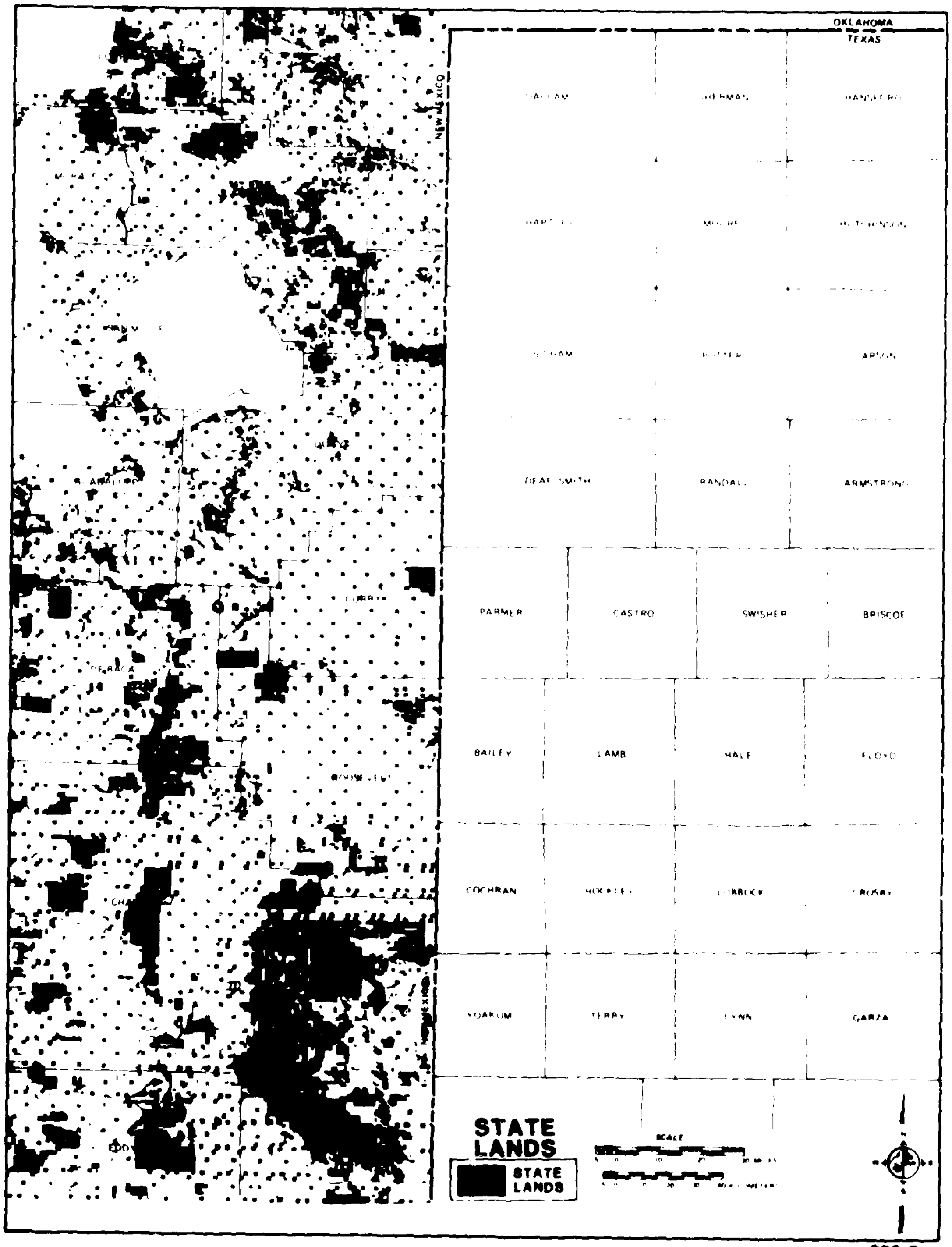

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Figure 3.3.3.7-3. State lands in the Texas/New Mexico study area.

Table 3.3.3.8-1. Farmland in Texas and New Mexico study area counties, 1974.

COUNTY	NUMBER OF FARMS	AVERAGE FARM SIZE ACRES	TOTAL ACREAGE IN FARMLAND	FARMLAND AS PROPORTION OF COUNTY LAND (PERCENTAGE)[1]	COUNTY FARMLAND AS PROPORTION OF STATE FARMLAND (PERCENTAGE)
Texas:					
Bailey	479	878	420,800	78.7	0.3
Castro	616	944	581,500	103.2	0.4
Cochran	297	1,376	408,600	81.6	[illegible]
Dallam	345	1,783	960,100	[illegible]	0.7
Deaf Smith	637	1,344	856,100	88.6	0.6
Hale	1,078	636	685,400	[illegible]	[illegible]
Hartley	196	4,657	[illegible]	[illegible]	[illegible]
Lamb	944	677	[illegible]	[illegible]	[illegible]
Moore	270	1,906	[illegible]	[illegible]	[illegible]
Oldham	154	5,296	[illegible]	[illegible]	[illegible]
Parmer	704	824	[illegible]	[illegible]	[illegible]
Randall	486	1,089	[illegible]	[illegible]	[illegible]
Sherman	300	1,865	[illegible]	[illegible]	[illegible]
Swisher	699	800	559,200	[illegible]	[illegible]
Total or average	7,205	1,252	[illegible]	—	[illegible]
New Mexico					
Chaves	517	5,316	2,771,600	71.2	5.9
Curry	636	1,316	837,200	93.3	1.8
DeBaca	177	7,198	1,274,000	84.5	2.7
Harding	175	7,874	1,377,900	100.9	2.9
Lea	512	4,404	2,254,900	80.2	4.8
Quay	607	3,226	1,957,900	106.4	4.2
Roosevelt	905	1,691	1,530,200	97.4	3.2
Union	416	4,916	2,045,000	83.7	4.3
Total or average	3,945	3,561	14,048,700	—	29.9
Texas/New Mexico Total	11,150	2,069	23,071,700	—	[illegible]

3212-1

[1]Includes all cropland, pastures, and grazing land except that on open ranges under government permit.

[2]Tabulated as being in the operator's principal county which is defined as the one with the largest value of agricultural products produced. This is where the operator reported all of the largest portion of his total land. As a result of this procedure, several counties exceed 100 percent.

Source: Department of Commerce, 1977.

Table 3.3.3.8-2. Trends in farming in Texas and New Mexico 1950-1974.

YEAR	NUMBER OF FARMS	ACREAGE IN FARMS	IRRIGATED ACREAGE IN FARMS	HARVESTED ACREAGE IN FARMS
Texas				
1950	331,567	145,389,000	3,132,000	28,108,000
1954	292,947	145,813,000	4,707,000	24,885,000
1959	227,071	143,218,000	5,656,000	22,236,000
1964	205,115	141,705,000	6,385,000	19,408,000
1969	213,550	142,567,000	6,888,000	19,825,000
1974	174,068	134,185,000	6,594,000	19,014,000
New Mexico				
1950	23,599	47,522,000	655,000	1,898,000
1954	21,070	49,451,000	650,000	1,135,000
1959	15,919	46,293,000	732,000	1,077,000
1964	14,206	47,646,000	813,000	906,000
1969	11,641	46,792,000	823,000	1,008,000
1974	11,282	47,046,000	867,000	976,000

3030-1

Source: Department of Commerce, 1977.

Table 3.3.3.8-3. Cropland acreage in Texas/New Mexico study area counties, 1974.

COUNTY	TOTAL CROPLAND	HARVESTED CROPLAND	CROPLAND USED ONLY FOR PASTURE	LAND IRRIGATED	CROPLAND AS PROPORTION OF STATE CROPLAND PERCENTAGE
Texas					
Bailey	299,000	137,000	20,000	119,000	0.8
Castro	441,000	330,000	25,000	295,000	1.2
Cochran	254,000	138,000	6,000	89,000	0.7
Dallam	324,000	212,000	31,000	111,000	0.8
Deaf Smith	510,000	285,000	31,000	238,000	1.4
Hale	574,000	468,000	34,000	401,000	1.6
Hartley	217,000	130,000	12,000	84,000	0.6
Lamb	451,000	327,000	18,000	277,000	1.2
Moore	228,000	154,000	11,000	121,000	0.6
Oldham	98,000	35,000	17,000	15,000	0.3
Parmer	446,000	349,000	22,000	339,000	1.2
Randall	289,000	123,000	37,000	77,000	0.8
Sherman	342,000	232,000	21,000	161,000	0.9
Swisher	400,000	278,000	39,000	252,000	1.1
TOTAL	4,873,000	3,198,000	324,000	2,579,000	13.4
New Mexico					
Chaves	95,000	78,000	12,000	84,000	4.3
Curry	426,000	172,000	42,000	145,000	19.4
DeBaca	11,000	5,000	4,000	7,000	0.5
Harding	34,000	4,000	11,000	7,000	1.6
Lea	86,000	52,000	20,000	62,000	3.9
Quay	252,000	70,000	43,000	38,000	11.5
Roosevelt	346,000	181,000	58,000	84,000	15.8
Union	90,000	35,000	29,000	27,000	4.1
TOTAL	1,340,000	597,000	219,000	454,000	61.2
TEXAS/NEW MEXICO TOTAL	6,213,000	3,795,000	543,000	3,033,000	16.1

3033

Source: Department of Commerce, 1977.

Table 3.3.3.8-4. Market value of agricultural products, Texas/New Mexico study area counties, 1974.

COUNTY	VALUE OF AGRICULTURAL PRODUCTS SOLD ($1000'S)	VALUE OF CROPS AND HAY (PERCENT OF TOTAL)	VALUE OF LIVESTOCK AND LIVESTOCK PRODUCTS (PERCENT OF TOTAL)	VALUE OF OTHER PRODUCTS (PERCENT OF TOTAL)	VALUE OF AGRICULTURAL PRODUCTS AS PROPORTIONAL OF STATE TOTAL (PERCENT)
Texas					
Bailey	48,083	39.8	60.2	0.0	0.8
Castro	204,810	30.1	69.7	0.2	3.6
Cochran	33,919	26.5	73.3	0.2	0.6
Dallam	64,233	33.4	66.5	0.1	1.1
Deaf Smith	266,871	19.3	80.7	0.0	4.7
Hale	136,017	50.0	49.9	0.1	2.4
Hartley	80,101	20.7	79.3	0.0	1.4
Lamb	67,734	74.3	25.4	0.3	1.2
Moore	101,819	23.6	76.4	0.0	1.8
Oldham	33,731	6.2	92.3	1.5	0.6
Parmer	261,487	30.9	69.1	0.0	4.6
Randall	107,970	10.6	88.4	1.0	1.9
Sherman	103,445	28.0	71.9	0.1	1.8
Swisher	124,913	28.3	71.6	0.1	2.2
TOTAL	1,635,133	—	—	—	29.0
New Mexico					
Chaves	84,146	20.6	79.4	0.0	16.1
Curry	59,479	36.9	63.0	0.1	11.4
DeBaca	6,562	15.3	84.7	0.0	1.2
Harding	5,415	3.3	96.6	0.1	1.0
Lea	24,710	29.8	69.7	0.5	4.7
Quay	27,352	15.8	84.1	0.1	5.2
Roosevelt	38,344	31.9	66.1	1.0	7.3
Union	38,580	8.1	91.8	0.1	7.4
TOTAL	284,588	—	—	—	54.6
REGIONAL TOTAL	1,919,721				13.2

3034

Source Department of Commerce, 1977.

Figures 3.3.3.8-1 and 3.3.3.8-2 show the location of irrigated and nonirrigated croplands. Approximately 50 percent of the proposed siting area is rangeland, and 50 percent of the livestock sold in Texas in 1974 was raised in the Texas portion of the study area (Figure 3.3.3.8-3).

Approximately 60 percent of the study area is used for grazing and pasture land. This grazing is entirely on private rangeland of the study area counties, except Chaves County, New Mexico, where the BLM administers certain grazing lands. Inventories of cattle and sheep are shown in Table 3.3.3.8-5. Cattle and sheep inventories have generally decreased in the periods shown in the New Mexico counties, while only the cattle inventory has decreased in the Texas counties.

Cattle feedlots are an important regional industry. Cattle are shipped to the region from as far away as New Hampshire. In New Mexico, nearly 60,000 cattle are fed annually in feedlots. This represents about 10 percent of all cattle in the region. It is an even larger industry in West Texas, with about 75 percent of the 1.47 million cattle in the Texas study area counties maintained in feedlots. Approximately two-thirds of the cost and one-third of the weight of the beef are added in the feedlots. The weight for the most part is fat, and it takes about nine pounds of irrigated corn to put a pound of fat on a calf or steer. About 2 million acre-ft of water are consumed annually, primarily for irrigated crops; the most demanding of which is corn. Water-intensive agriculture is expected to decrease about 7 percent by the year 2000. The decrease is in response to an increasing shortage constraining development. For example, as water loss due to overdrafts of the Ogallala aquifer continues, corn production will decrease. Since over 95 percent of the corn is used in regional feedlots, the feedlots may go out of business. Cattle will either have to be shipped out of the region for fattening in other feedlots (Colorado, Nebraska, Iowa, etc.) or the diet of Americans will have to accommodate range fed beef.

Water-Based Recreation

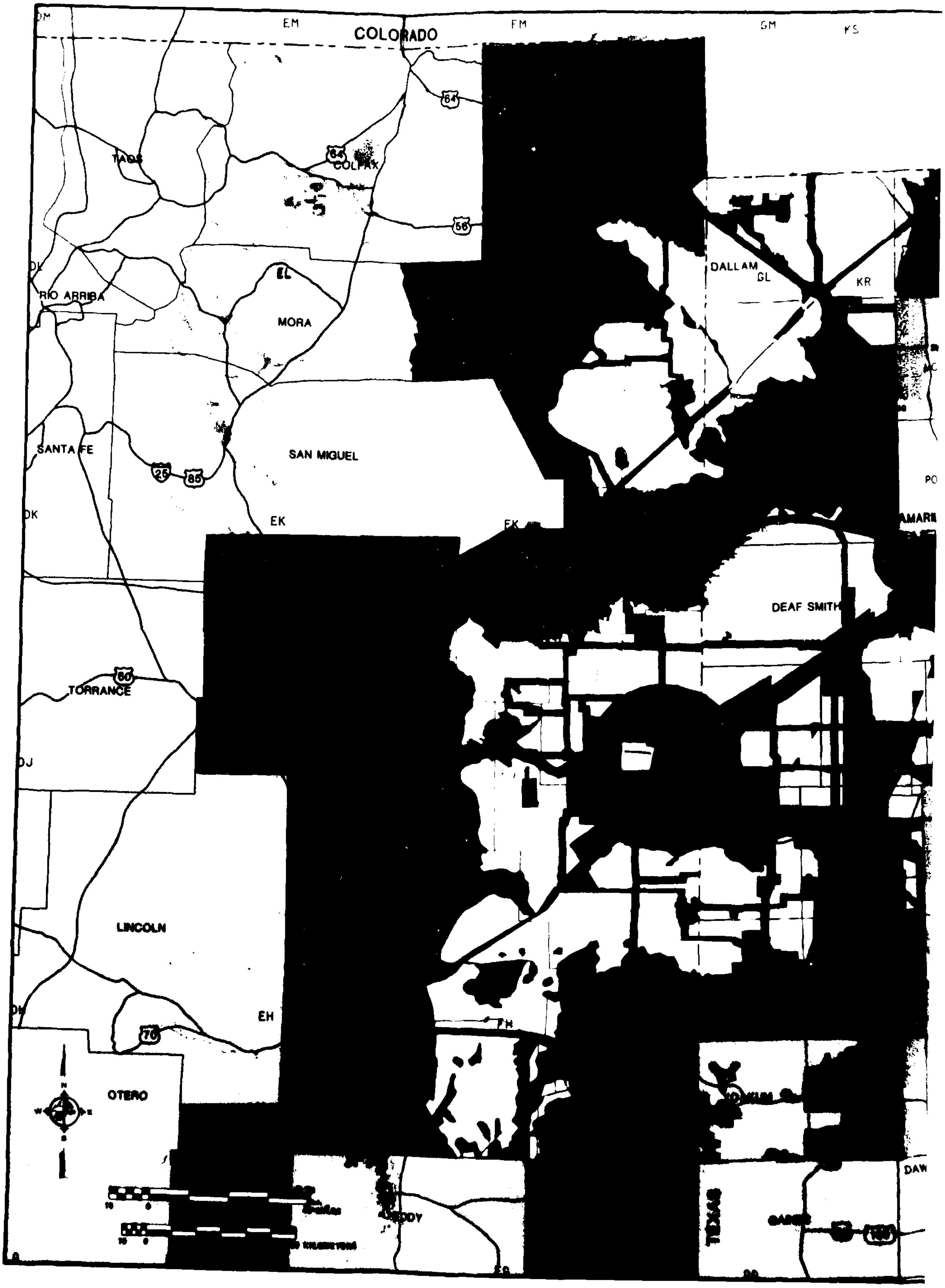
Swimming, boating, fishing, and waterskiing are the major water-oriented recreational activities. Other recreational activities such as picnicking and hiking are also enhanced by the availability of nearby water. Tables 3.3.3.8-6 and 3.3.3.8-7 list major water bodies; these are located in Figure 3.3.3.8-4. Lake Meredith is the primary source of water-based recreation in this region of Texas.

Off-Road Vehicle (ORV) Recreation

No designated or high-quality (greater than 2,000 annual visits) ORV use-areas have been identified.

Hunting

Big game hunting is not an important activity because these species are primarily in habitats east or north of the project area. For example, white-tailed deer population estimates range from zero in 13 of the 15 High Plains counties of Texas to [illegible] in Moore and Randall and 200 in Potter counties (Travis, 1980). An [illegible] aerial census of pronghorn shows that the bulk of the antelope herd is found in the northern portion of the project area, in Oldham, Hartley, Dallam, Union, Harding and Potter counties (Travis, 1980; Snyder, 1979). An inventory of the big game in the High Plains Red River drainage area is shown in Table 3.3.3.8-8.



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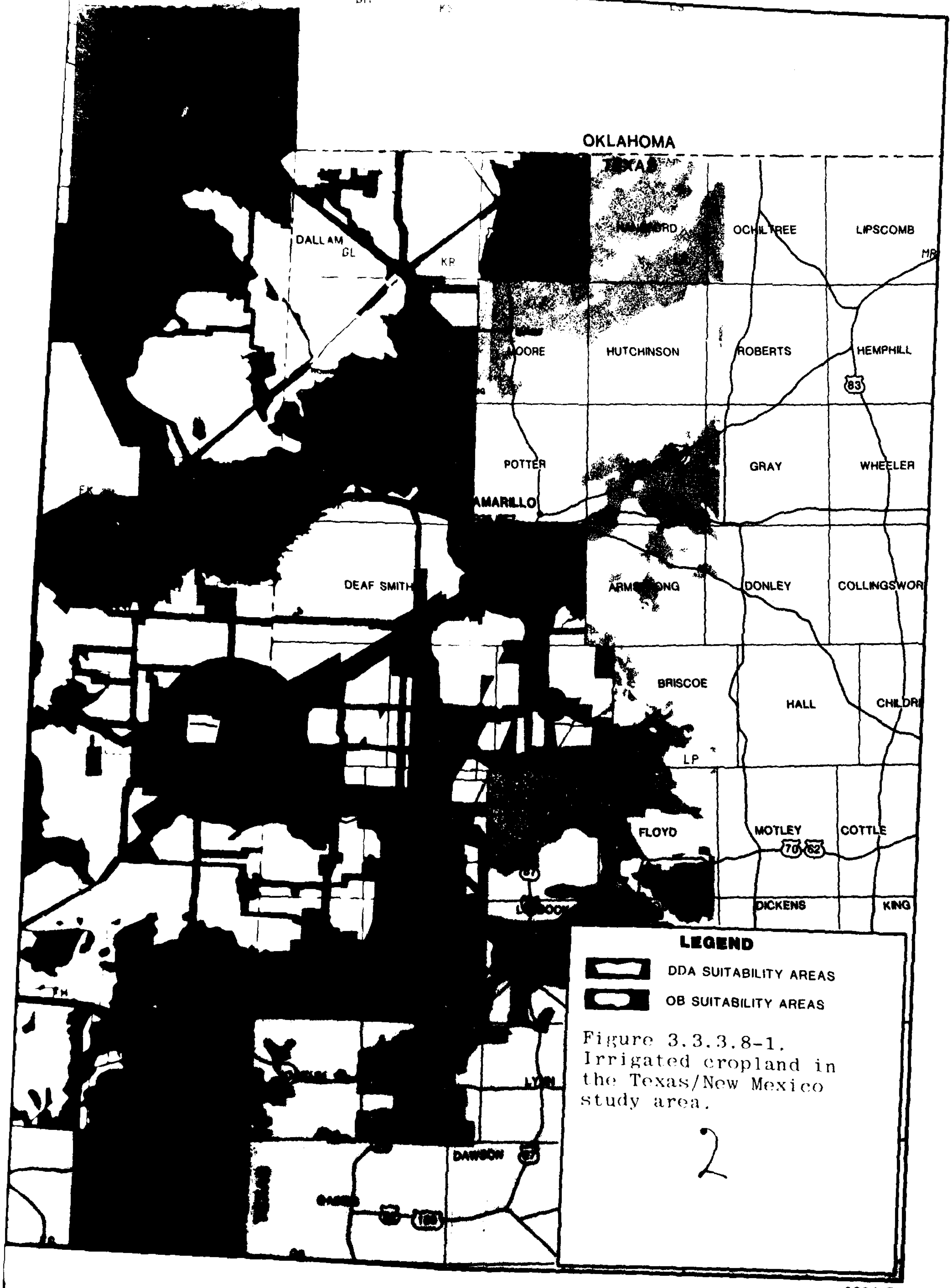

Figure 3.3.3.8-1. Irrigated cropland in the Texas/New Mexico study area.

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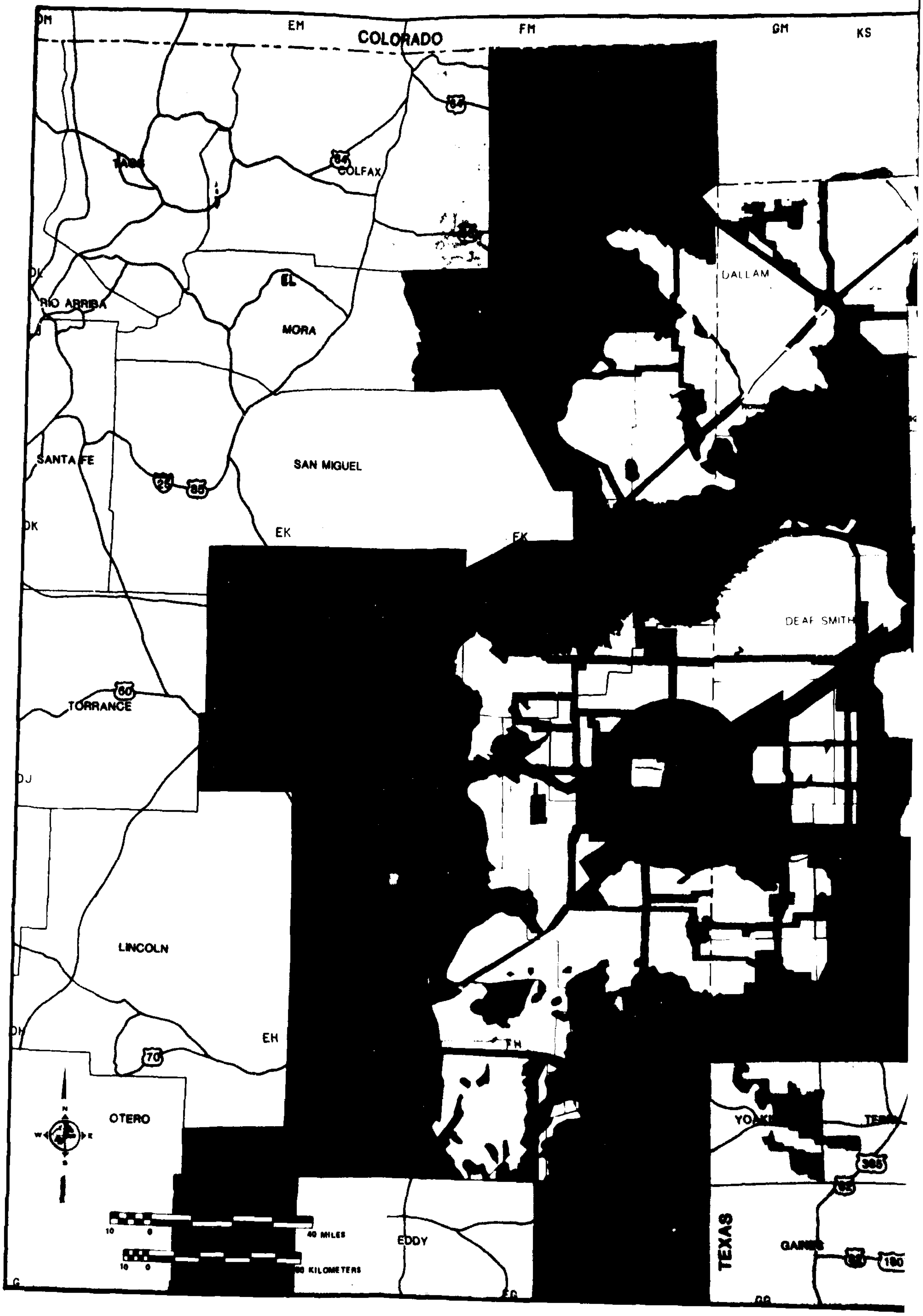
3234-D



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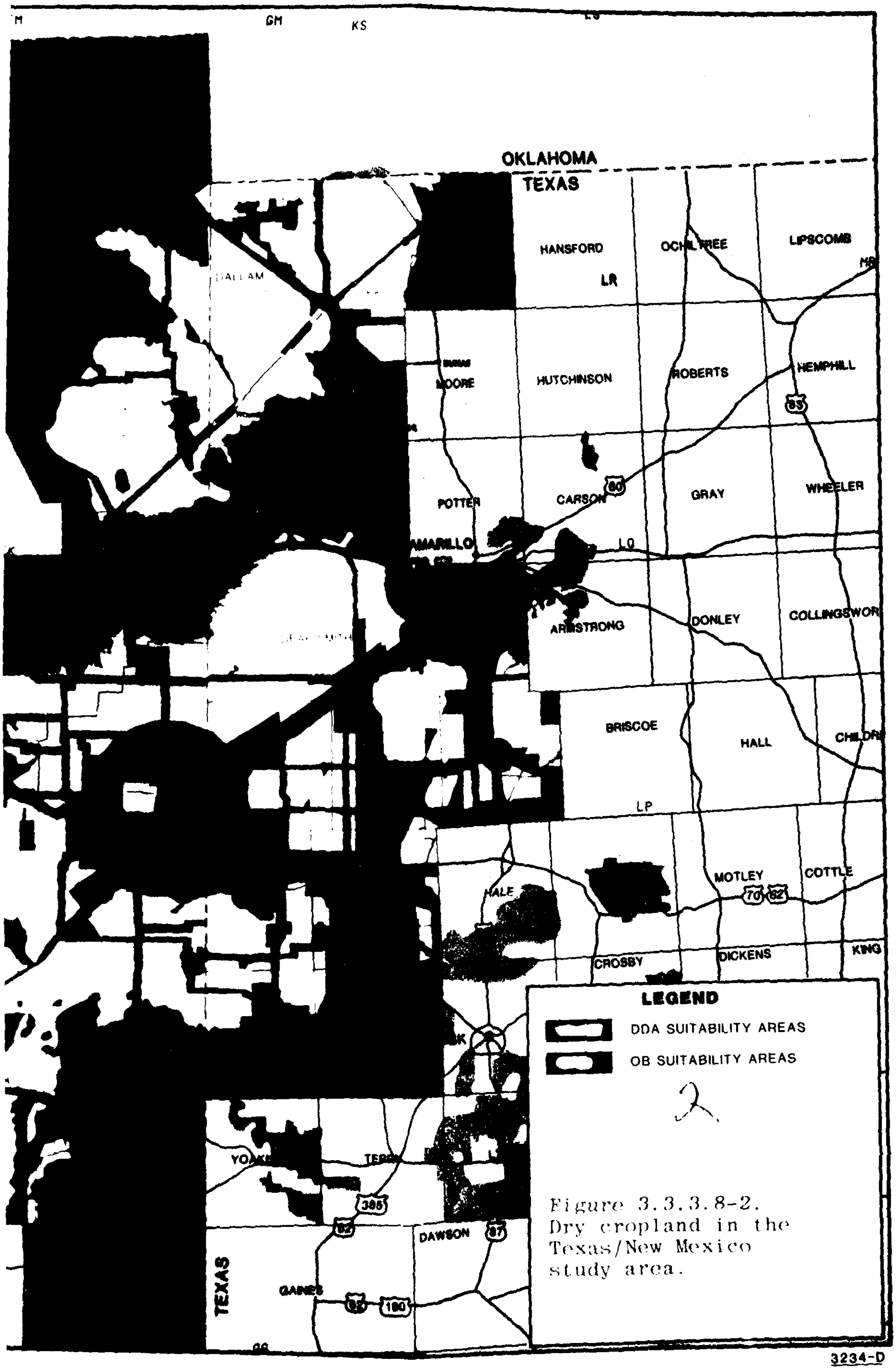

Figure 3.3.3.8-2. Dry cropland in the Texas/New Mexico study area.

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FJ
LINCOLN
OTERO
DAWSON
TEXAS
GAINS

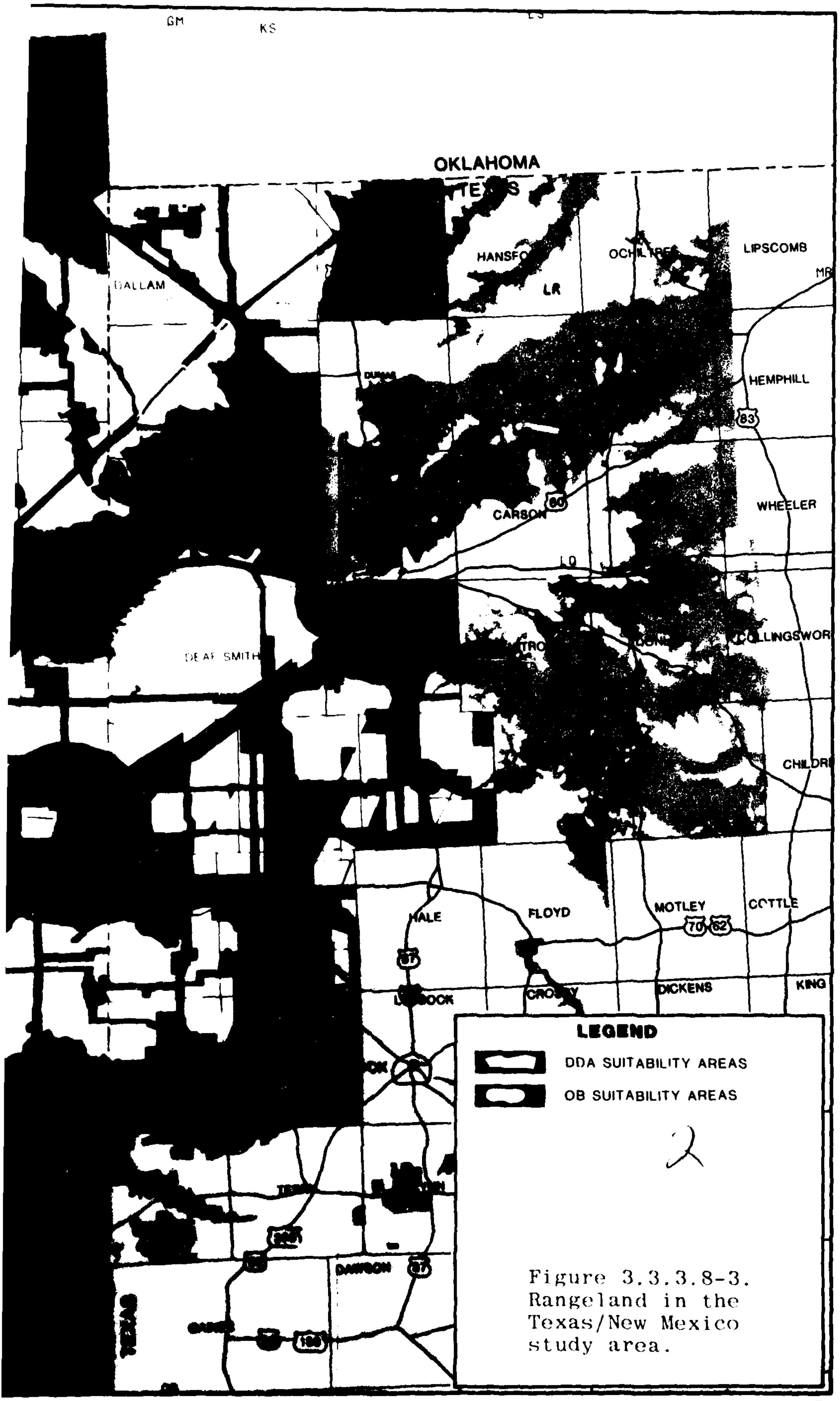

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Figure 3.3.3.8-3. Rangeland in the Texas/New Mexico study area.

3234-D

Table 3.3.3.8-5. Livestock inventories, Texas/ New Mexico study area counties (thousands of head).

STATE/COUNTY	CATTLE[1]			SHEEP		
	1969 NUMBER	1974 NUMBER	STATE TOTAL (PERCENT)	1969 NUMBER	1974 NUMBER	STATE TOTAL (PERCENT)
Texas						
Bailey	42	47	0.4	6	3	0.1
Castro	149	186	1.4	6	30	1.0
Cochran	47	30	0.2	1	*	—
Dallam	94	92	0.7	*	*	—
Deaf Smith	305	227	1.7	8	*	—
Hale	101	93	0.7	3	3	0.1
Hartley	53	109	0.8	*	*	
Lamb	51	41	0.3	4	5	0.2
Moore	79	78	0.6	*	*	
Oldham	58	64	0.5	1	1	0.3
Parmer	192	158	1.2	1	3	0.1
Randall	164	96	0.7	4	1	0.03
Sherman	132	99	0.7	*	*	—
Swisher	108	142	1.1	1	1	0.03
Texas Totals	1,575	1,462	10.9	35	47	1.5

STATE/COUNTY	CATTLE			SHEEP		
	1974 NUMBER	1978 NUMBER	STATE TOTAL (PERCENT)	1974 NUMBER	1978 NUMBER	STATE TOTAL (PERCENT)
New Mexico						
Chaves	141	139	9.0	149	110	19.3
Curry	87	100	6.5	4	6	1.1
De Baca	38	39	2.5	19	16	2.8
Harding	47	48	3.1	1	1	0.2
Quay	91	60	3.9	2	2	0.4
Roosevelt	89	66	4.3	3	5	0.9
Union	168	80	5.2	1	1	0.2
New Mexico Totals	661	532	34.3	179	141	24.7

1384-1

*Less than 500 sheep.

[1]Does not include dairy cattle.

Sources: U.S. Department of Commerce, 1977; University of New Mexico, 1980.

Table 3.3.3.8-6. Recreational lakes and streams in the New Mexico study area.

COUNTY	STREAMS	LAKES WITH GREATER THAN 40 SURFACE ACRES
Union	Perico Cimarron (100 mi) Carrizozo North Canadian (Seneca) Carrizo Ute Tramperos	Clayton Lake Weatherly Lake Pasamonte Lake
Quay	Ute Canadian (50 mi) Conchas Canal Plaza Largo	Ute Res. Tucumcari Lake Hudson Lake
Curry	Frio	La Tule Lake
Roosevelt		Lewiston Lake Salt Lake Little Salt Lake
De Baca	Pecos (80 mi)	Red Lake Alamogordo Res.
Chaves	Rio Penasco (40 mi) Rio Hondo (47 mi) Arroyo del Macho Rio Felix Pecos (118 mi)	Bitter Lakes (7) Two Rivers Res. Roswell Saline Zuber Lake Lake Van

2804

Table 3.3.3.8-7. Recreational lakes and streams in the Texas study area counties.

COUNTY	STREAMS	LAKES
Dallam	Carrizo Mustang (West Rita Blanca) Cold Water	
Hartley	Punta de Agua Rita Blanca	
Oldham	Rita Blanca Canadian	Lake Meredith (portion)
Moore	S. Palo Duro	Lake Meredith (portion)
Deaf Smith	Palo Duro Tierra Blanca Frio	
Randall	Palo Duro Tierra Blanca	Buffalo Lake
Parmer	Frio Running Water	
Castro	Running Water Frio	
Swisher	Tule	
Bailey	Blackwater	
Lamb	Blackwater Running Water	
Hale	Blackwater Running Water	
Cochran	Sulphur Draw	

2803

Table 3.3.3.8-8. Wildlife inventory estimates in the High Plains drainage area of the Red River.[1]

SPECIES	HABITAT (ACRES)	TOTAL POPULATION
White-Tailed Deer	55,850	30
Mule Deer	73,260	380
Aoudad (Barbary Sheep)	55,850	150
Pronghorn	—	—
Rio Grande Turkey	72,330	130
Ring-Necked Pheasant	1,239,770	47,850
Lesser Prairie Chicken	—	—
Quail	2,578,830	23,200
Mourning Dove	3,070,000	185,520
Fox Squirrel	23,040	90
Ducks	35,370	176,850
Geese	35,370	35,370

2817

[1]From U.S.D.A., Special Report, 1976.

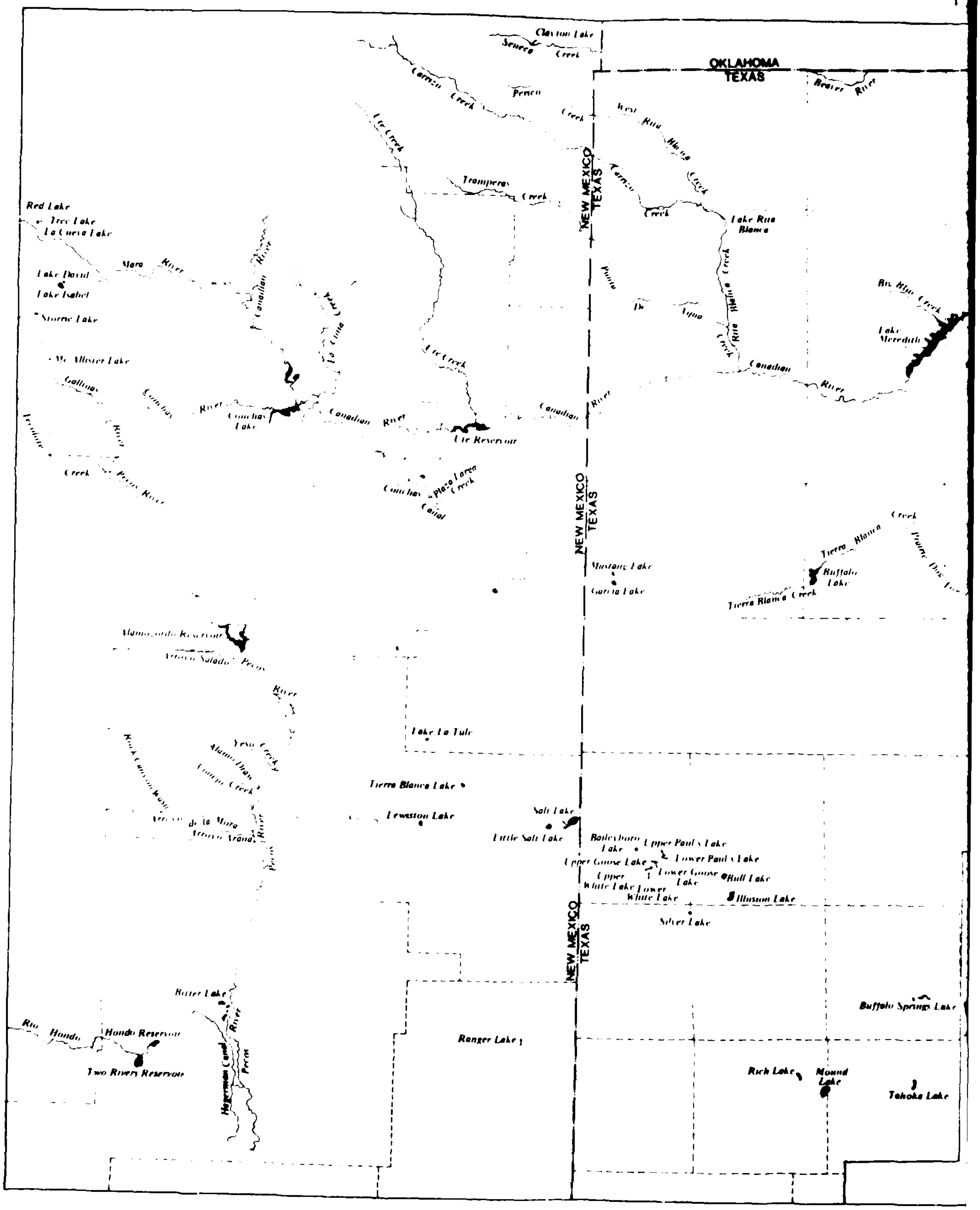

Figure 3.3.3.8-4. Ma

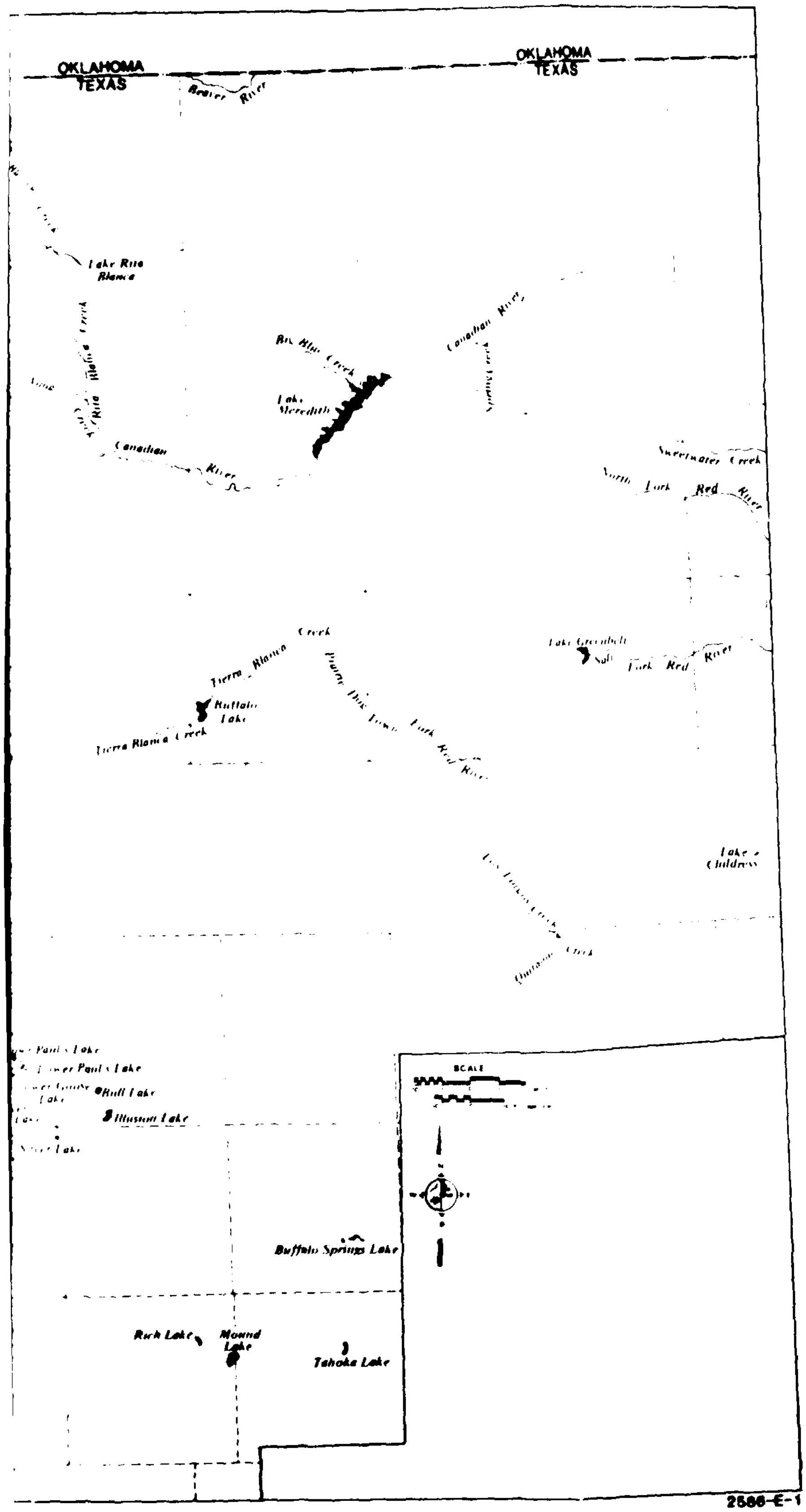

Figure 3.3.3.8-4. Major bodies of water in Texas/New Mexico study area.

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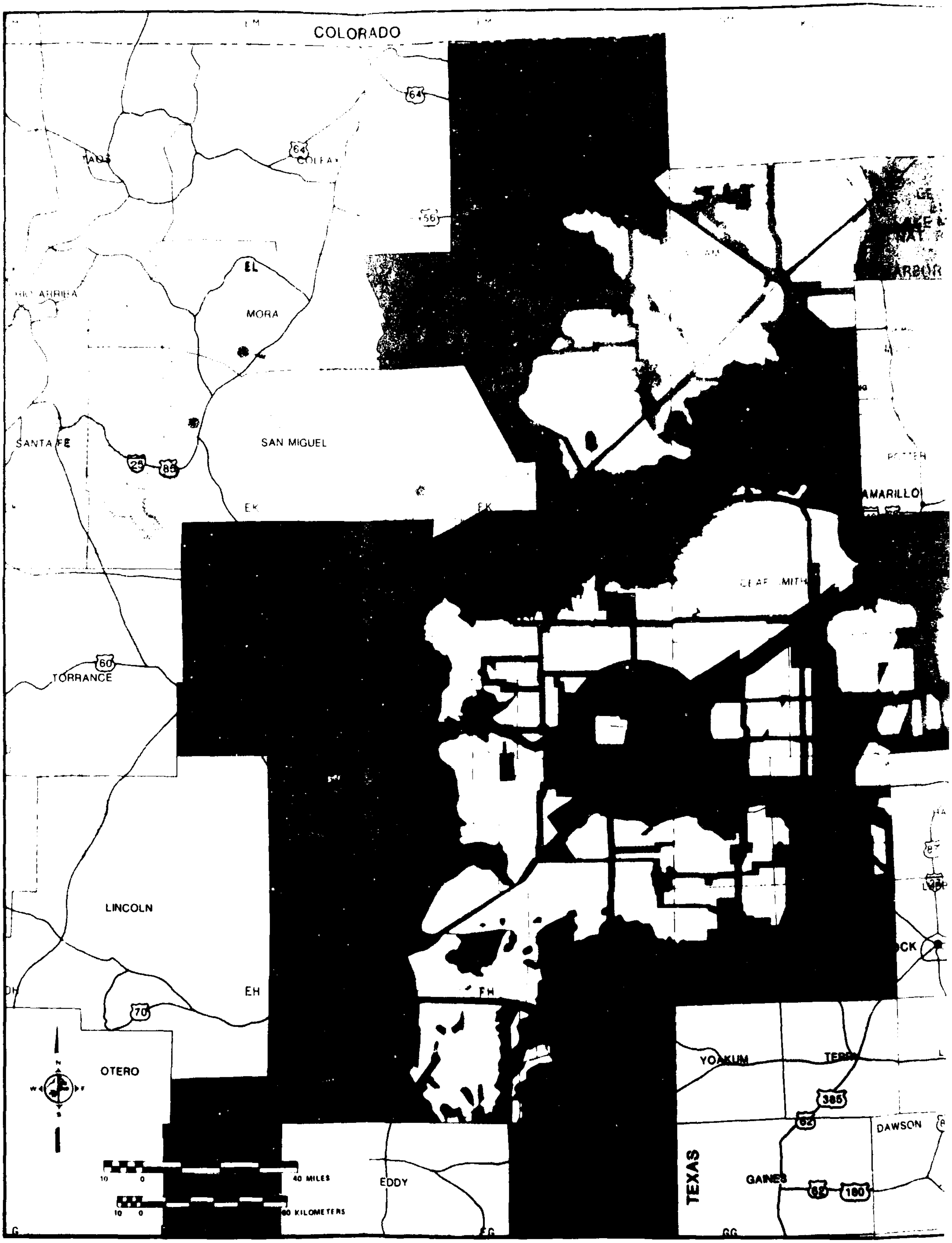

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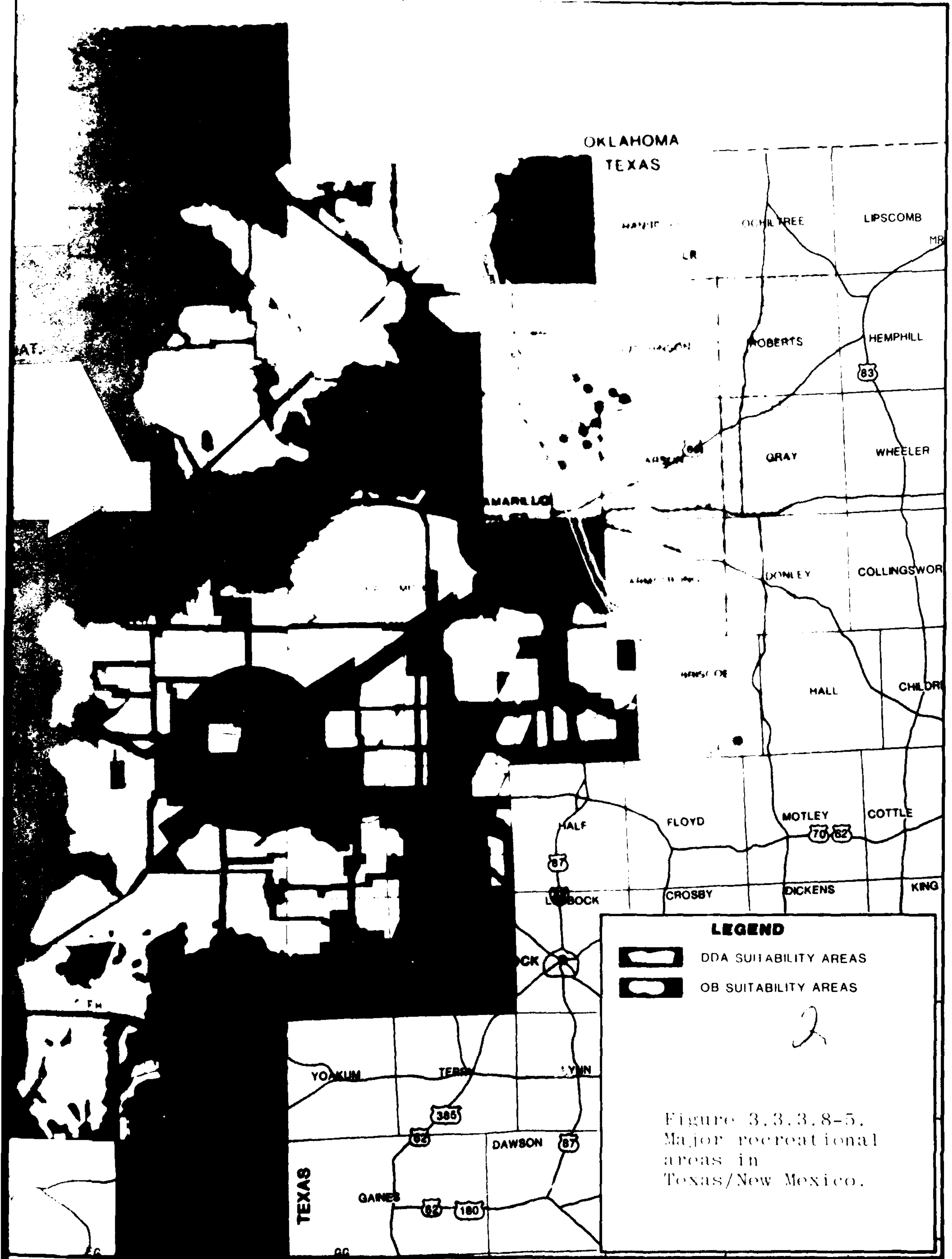

Figure 3.3.3.8-5. Major recreational areas in Texas/New Mexico.

3234-D

Table 3.3.3.8-9. Major parklands and recreational facilities in New Mexico study area counties.

COUNTY	ADMINISTERING AGENCY	PARK AREA NAME
De Baca	New Mexico Parks and Recreation Commission	Summer Lake State Park
Chaves	New Mexico Parks and Recreation Commission	Bottomless Lakes State Park
	U.S. Fish and Wildlife Service	Bitter Lakes National Wildlife Refuge
	U.S. Forest Service	Lincoln National Forest (portion)
Curry	No major parklands	
Quay	New Mexico Parkland Recreation Commission	Ute Lake State Parks
Roosevelt	New Mexico Parks and Recreation Commission	Oasis State Park
	U.S. Fish and Wildlife Service	Grulla National Wildlife Refuge
Union	New Mexico Parks and Recreation Commission	Clayton Lake State Park
	National Park Service	Capulin Mountain National Monument
	U.S. Forest Service	Kiowa National Grasslands (portion)
Harding	New Mexico Parks and Recreation Commission	Chicosa Lake State Park
	U.S. Forest Service	Kiowa National Grasslands (portion)
San Miguel	New Mexico Parks and Recreation Commission	Conchas Lake State Park
	New Mexico Parks and Recreation Commission	Storrie Lake State Park
	New Mexico Parks and Recreation Commission	Villanueva State Park
	U.S. Forest Service	Santa Fe National Forest (portion)
	U.S. Fish and Wildlife Service	Las Vegas National Wildlife Refuge

2864

Sources: New Mexico State Comprehensive Outdoor Recreation Plan 1976; State Parks for New Mexico's Future 1975; Rand McNally Road Atlas. (U.S., Can., Mex.).

Table 3.3.3.8-10. Major parklands and recreational facilities in Texas study area counties.

COUNTY	ADMINISTERING AGENCY	PARK/AREA NAME
Dallam	U.S. Forest Service	Rita Blanca National Grasslands
Sherman	No major parklands	
Moore	National Park Service	Lake Meredith National Recreation Area (portion)
Potter	National Park Service	Lake Meredith National Recreation Area (portion)
	National Park Service	Alibates Flint Quarries National Monument
Oldham	No major parklands	
Deaf Smith	No major parklands	
Randall	U.S. Fish and Wildlife Service	Buffalo Lake National Wildlife Refuge
	Texas Department of Parks and Wildlife	Palo Duro Canyon State Park (portion)
Parmer	No major parklands	
Castro	No major parklands	
Swisher	No major parklands	
Briscoe	Texas Department of Parks and Wildlife	Caprock Canyon State Park
Bailey	U.S. Fish and Wildlife Service	Muleshoe National Wildlife Refuge
Lamb	No major parklands	

2865

Source: Rand McNally Road Atlas (U.S., Can., Mex.).

Sacred Areas

Rock art sites are recorded for Winkler, Briscoe, Motley, Randall, Potter, Armstrong, and Oldham counties. Caves, rockshelters, and rock crevices were favored for internments, and graves associated with the Apache and Comanche are known in Lubbock, Garza, and Crosby counties.

Also, sacred significance is attached to established trails and to rock cairns or shrines established for ceremonial purposes along these trails. The removal of Apache and Comanche peoples from these ancestral lands has eroded tribal knowledge of traditional sites and features, and locations are poorly documented.

Socieconomic Environment (3.3.3.9.2)

There are no Native American reservations lease lands, grazing lands, or other lands in the study area.

Archaeological and Historial Resources (3.3.3.10)

National and State Register Properties (3.3.3.10.1)

National Register properties are illustrated in Figure 3.3.3.10-1.

Archaeological Resources (3.3.3.10.2)

This area contains most of what is known as the Southern High Plains. It can be divided into four geographically distinct areas (Figure 3.3.3.10-2). The Llano Estacado is the largest. Aboriginal activities in this region were greatly affected by the availability of water and approximately 90 percent of the sites recorded are within one mi of a permanent or seasonal water source. The most archaeologically important areas are the draws, their environs, and the margins of lakes and playas (intermittent or now dry lakes). Paleoindian sites of up to one mi away from draws have been mapped; playas are frequently bordered by dunes, which may contain campsites dating as far back as the Paleoindian period; dune areas may also contain Neoindian and Apache permanent or semipermanent agricultural villages. Kill sites and campsites are found in the canyons and gullies of the north, east, and west edges of the Llano, particularly near the heads of ephemeral streams draining off the escarpment (Table 3.3.3.10-1).

The Canadian River Valley, in contrast to the Llano, contains no well known Paleoindian sites, although some are adjacent to it. The best known period in this area is the Neoindian, specifically the time between A.D. 1200 and 1450, when sedentary agricultural villages are found along the Canadian River and its tributaries. Sensitive areas in the Canadian River Valley would include village sites (on terraces, ridge tops, and mesas), bottomlands, gullies and blind canyons, and caves and rock shelters.

The Panhandle High Plains site types and distributions are largely tied to two kinds of water sources and natural animal traps. Kill sites and campsites from all periods can be expected. Mesa/butte tops and sides contain extensive campsites from any period.

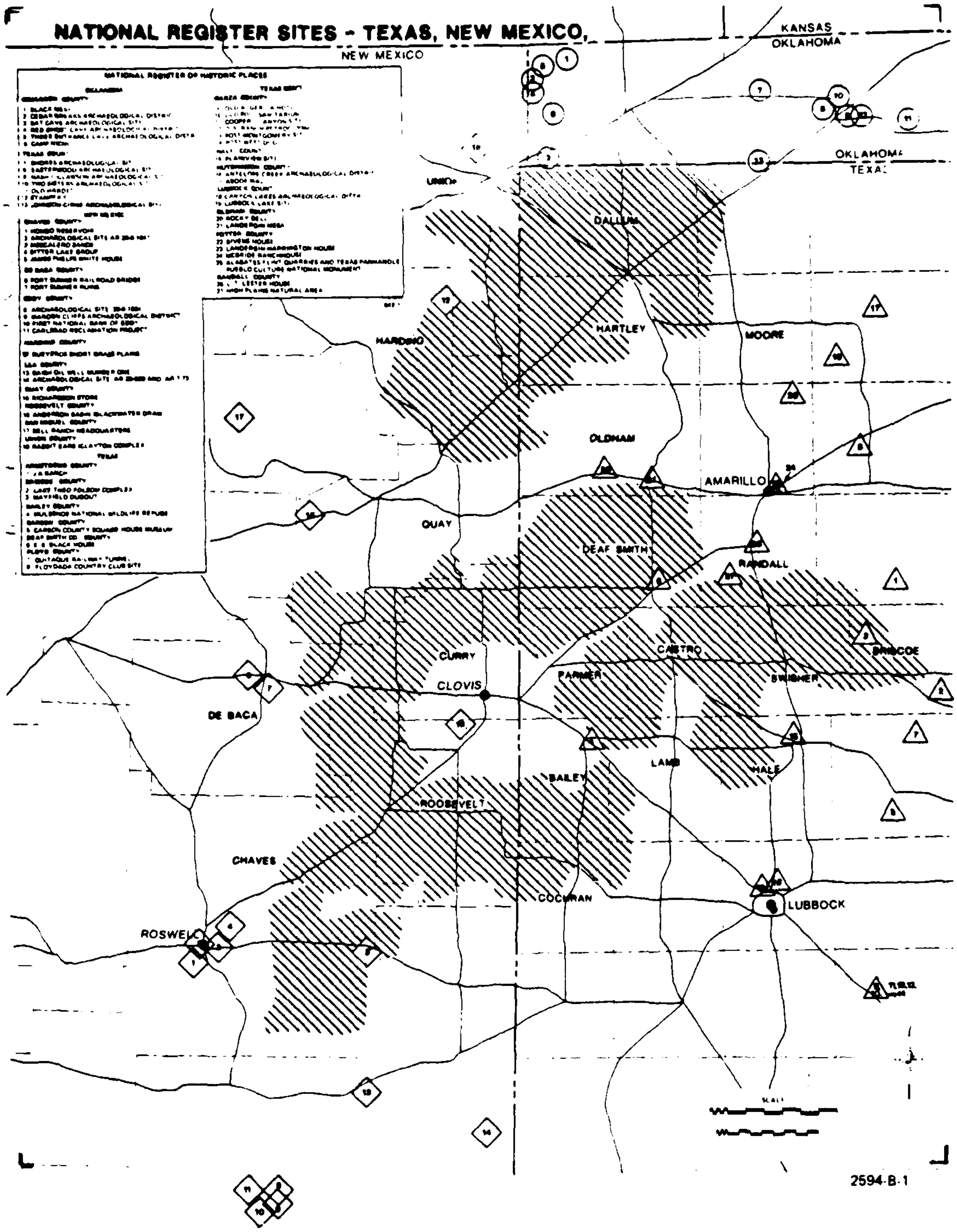

Figure 3.3.3.10-1. National Register sites in and near the Texas/New Mexico geotechnically suitable area (hatched).

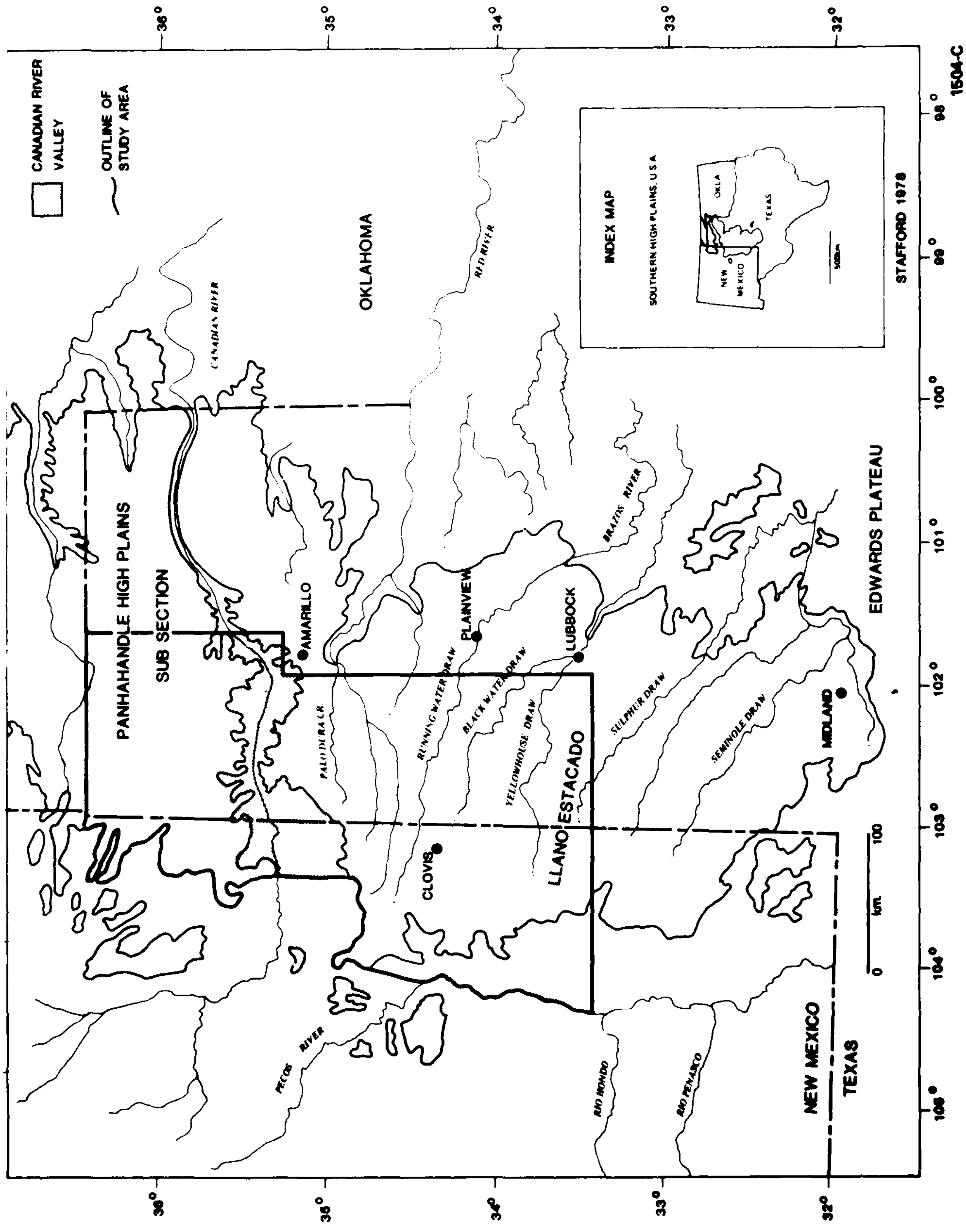

Figure 3.3.3.10-2. Geographically distinct areas of the Southern High Plains.

Table 3.3.3.10-1. Numbers of recorded archaeological sites in the southern portion of Llano Estacado.

WITHIN STUDY AREA	
COUNTY	NUMBER OF RECORDED SITES
Cochran, Texas	2
Bailey, Texas	7
Hale, Texas	54; Plainview site on National Register
Lamb, Texas	22
Castro, Texas	2
Parmer, Texas	7
Swisher, Texas	26
Curry, New Mexico	18
Roosevelt, New Mexico	296; Blackwater Draw locality No. 1/ Anderson Basin on National Register
ADJACENT TO STUDY AREA	
COUNTY	NUMBER OF RECORDED SITES
Crosby, Texas	31
Floyd, Texas	100; Floydada Country Club Site on Nation Register
Hockley, Texas	5
Lubbock, Texas	175; Lubbock Lake Site and Canyon Lakes District on National Register
Lynn, Texas	138
Terry, Texas	76
Garza, Texas	626; Cooper's Canyon Site, O.S. Ranch Petroglyphs, and Post-Montgomery Site on National Register
Yoakum, Texas	3

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Paleontological Resources (3.3.3.10.3)

Important vertebrate fauna resources are found in Hemphill County. The Hemphillian fauna is found in the upper 130 ft of the Ogallala Formation and could be found in the Dalhart area. Pleistocene deposits on top of the Ogallala could also contain fossils. Fossils along the western escarpment are not common, consisting mostly of gastropods and seeds.

Construction Resources (3.3.3.11)

The M-X system will require substantial quantities of a number of construction resources to meet the needs of both direct and indirect construction activity. Those resources considered most significant and deserving of mention are cement, steel (mostly rebar steel), asphaltic oil, aggregate and lumber.

Cement (3.3.3.11.1)

Under the assumption that M-X is deployed in Texas/New Mexico the r gional cement supply is as shown in Table 3.3.3.11-1. The supply is in exce of the demand and in most cases the state potential production is greater than the actual production, leaving residual capacity (Table 3.3.3.11-2).

Steel (3.3.3.11.2)

Of all the steel utilized by the M-X system, 98 percent will be in the form of reinforcing bar steel (rebar) employed in reinforced concrete construction. The production of rebar takes place in plants much smaller in size than iron and steel plants and which are much more frequent in their geographical distribution. Producer of rebar exist in a number of states considered to be within the M-X supply region: California, Oregon, Wahsington, Utah, Arizona, and Colorado. Their combined estimated rebar capacity as of 1979 was over 1.5 million times annually which exceeds the regional consumption by over half a million tons.

With deployment in Texas/New Mexido, the available supply of rebar increases with the addition of suppliers in Texas and Alabama. Their combined addition amounts to just in excess of 1.25 million tons. Which is more than double the apparent 1978 regional consumption of just over 630,000 tons.

Asphaltic Oil (3.3.3.11.3)

The demand for asphaltic oil originates in two sources: as a component of asphaltic concrete of which it makes up 5.6 percent by weight; and as road bed coating and realing oil.

Excess capacity presently exists within the regional supply area and two asphalt suppliers in southern California report that their combined capacity will be over four times the peak year requirements for M-X. Spokes people for the two companies indicated that the asphalt market is presently depressed due primarily to a major change in federal transportation funding which has reduced highway construction significantly.

Table 3.3.3.11-1. Texas/New Mexico market area production of Portland cement by district, 1969-1978.

THOUSANDS OF SHORT TONS							
YEAR	LOUISIANA AND MISSISSIPPI	MISSOURI	KANSAS	OKLAHOMA AND ARKANSAS	TEXAS	COLORADO, ARIZONA, UTAH, AND NEW MEXICO	TOTAL
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960	1,366	2,370	1,503	1,345	4,359	2,238	13,181
1961	1,243	2,244	1,566	1,709	4,678	2,581	14,021
1962	1,480	2,301	1,548	1,802	4,970	2,550	14,651
1963	1,583	2,386	1,550	2,124	5,479	2,549	15,671
1964	1,701	2,331	1,567	2,144	5,600	2,413	15,756
1965	1,696	2,627	1,669	2,274	5,784	2,222	16,272
1966	1,739	2,623	1,724	2,353	5,919	2,191	16,549
1967	1,681	2,798	1,696	2,325	6,067	2,063	16,630
1968	1,578	3,723	1,858	2,366	6,421	2,274	18,220
1969	1,427	3,921	1,830	2,421	6,734	2,263	18,596
1970	1,289	3,897	1,687	2,083	6,501	2,598	18,055
1971	1,486	4,144	1,799	2,374	7,138	2,954	19,895
1972	1,602	4,329	1,986	2,604	7,884	3,145	21,550
1973	1,479	4,359	2,036	2,746	8,312	3,441	22,373
1974	1,699	4,298	1,996	2,695	9,961	3,351	24,000
1975	1,330	3,919	1,835	2,232	7,074	3,295	19,685
1976	1,551	4,334	1,950	2,620	7,438	3,524	21,417
1977	1,538	4,551	2,072	2,771	8,223	3,858	23,013
1978	1,586	4,620	2,063	2,774	8,624	3,899	23,566

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Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

Table 3.3.3.11-2. Portland cement capacity utilization Texas/New Mexico market area, 1973-1978.

Year	Louisiana and Mississippi	Missouri	Kansas	Oklahoma and Arkansas	Texas	Colorado Arizona Utah and New Mexico
1973	79.5%	90.4%	95.1%	80.9%	83.9%	72.4%
1974	64.2	83.4	92.0	78.3	79.2	[illegible]
1975	[illegible]	[illegible]	78.3	64.6	71.1	[illegible]
1976	70.7	85.8	83.8	75.6	76.5	[illegible]
1977	[illegible]	87.3	88.5	80.9	84.3	[illegible]
1978	79.6	89.4	85.5	80.4	79.3	[illegible]
Six Year-Average	70.2%	85.1%	87.2%	76.8%	79.1%	[illegible]

Source: U.S. Department of the Interior, Bureau of Mines, <u>Minerals Yearbook</u>

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Aggregate (3.3.3.11.4)

Aggregate is virtually a ubiquitously occuring resource which, in addition, is transported only small distances because of both its low value and bulky nature. With M-X deployment in Nevada/Utah preliminary field reports indicate that basin fill is of good quality and that substantial recover exist throughout the deployment area.

Lumber (3.3.3.11.5)

M-X peak year demand for lumber amounts to 0.3 percent of national production and at present western lumber inventories and mill capacity are in excess of demand. The demand level exerted by M-X related construction can be considered no more than round-off error in production estimates.

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